MODELLING SMOKING MOTIVATION: MOOD, PERSONALITY AND APPETITIVE BEHAVIOUR

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ABSTRACT

The overarching aim of this research was to investigate the role of affectivity in real-world smoking behaviour. The motivational relationship between affect and smoking was conceptualised within an interactive hierarchical framework: assessing associations with natural situational variability over time, and moderation by relevant individual differences (chiefly, BIS-BAS scores - as reflecting affective disposition/motivational sensitivity).

An initial questionnaire study was undertaken towards the development of a diary design that would be useful in capturing experiences around everyday smoking behaviour (Chapter 4). This design was then applied in a series of diary studies that were set up to address questions pertaining to the central aim of the research. The main body of the thesis is structured around these areas of enquiry.

Chapter 5 tested competing theoretical models of mood-smoking motivation in everyday contexts and Chapter 6 extended this investigation hierarchically: to ascertain whether there are individual differences in identified motivational experiences. Chapter 7 compared smoking with natural appetitive behaviour (food consumption) to better demarcate parts of the motivational process that might be set awry in reinforcement of non-natural consumption. The influence of more general periodic shifts in motivational experiences and behaviour on consumption/desire to consume was examined in Chapter 8. The final investigative chapter (Chapter 9) compared processes identified for normal smoking behaviour with processes during deprivation/abstinence. Each chapter draws on data from the diary studies as appropriate.

Findings were generally congruent with other naturalistic research in supporting positive mood enhancement (principally, anticipatory elevation of hedonic tone) as

a motivation for normal smoking. BAS reward-sensitivity moderated hedonic incentive effects, but not in the expected direction. Comparisons with natural consumption behaviour suggested that motivations for natural appetitive rewards may differ from those for acquired substance use. Notably, smoking motivations changed somewhat during deprivation, when tense arousal and frustration emerged as operative factors.

Chapter 10 considers the implications of the research for models of mood and personality. These include implications for conceptualising reinforcement sensitivity.

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Chapter 1. Introduction

1.1 General Introduction

This thesis will examine the role of affectivity in smoking behaviour. Research will consider the role of affectivity at different levels of temporal stability/situational specificity – from transient states (acute affective responses and mood) to stable affective-dispositions (personality) – and how these might interact in relation to smoking motivation and behaviour embedded in time.

1.1.1 Smoking motivation

Smoking is the most prevalent preventable cause of death in the UK (Callum, 1998), yet the aetiology of smoking behaviour and dependence (onset, maintenance, and relapse) is unclear (Schmitz, Schneider, & Jarvik, 1997). One reason for this is the extent to which relevant models must account for the similarly elusive domains of human motivation and affective response systems (Elster, 1999). Within current models of substance use, affective constructs are generally latent concepts. For example, in behavioural-learning models, the incorporation of affective motivation is implicit within the context of reinforcing substance-properties: an elicited impetus to regain previously-experienced euphoric effects (positive reinforcement) and/or assuage withdrawal-like states (negative reinforcement). The present research makes the motivational relationship between mood and smoking its direct focus. Uniquely, this relationship will be investigated in an interactive framework examining: (a) its association with natural contextual variability; and (b) its moderation by theoretically relevant individual variability (chiefly, trait affectivity). Trait and situational approaches to the investigation of smoking motivation have previously been distinct - despite identification of a need

to relate the momentary characteristics of smoking to individual differences (Shiffman *et al.*, 1997a).

To reiterate, the present approach to examining smoking motivation centres on possible interactions of mood, contextual associations, and personality.

Mood

Affective responding is closely linked to motivation (Baker, Brandon, & Chassin, 2004a) and an understanding of the relationship between smoking and affect might facilitate better comprehension of smoking behaviour and mechanisms of dependence (Kassel, Stroud, & Paronis, 2003). To the extent that subjective experiences index these mechanisms, reports indicate that mood modification is a motivationally significant function of smoking (Marsh & Mathieson, 1983). Research to date is supportive of the need for investigation of mood-smoking relationships (Wetter *et al.*, 2004), although previous findings in this regard have been inconclusive (Zinser *et al.*, 1999). Much of the research to date has been laboratory-based, and there is a need for convergent research in natural settings.

Contextual associations and craving

Much of the variation in the affect of an individual is attributable to unique contextual cues (such as particular activities) related to activation or inhibition of the individual's goal-directed behaviour (Clark & Fiske, 1982; Mandler, 1984). The present research will attempt to sample and model some of the contextual correlates of smoking that may interact with affective aspects of use behaviour - for example, the external state (location and company) within which smoking occurs. Demonstrably, situational stimuli that surround smoking and smoking rituals can come to prompt smoking behaviour through learning processes (Lazev *et al.*, 1999). These contextual cues derive meaning from their occurrence in conjunction with mood-regulatory functions of smoking (Quirk, 2001).

The subjective experience of urge to smoke (craving) may represent a cognitive summation of affective cues, contextual cues, and smoking as a potential response (Halikas, 1997). As such, craving might mediate the influence of mood-context on behaviour. At minimum, it is likely to reflect motivational variability relevant to current investigation. The present research will assess this experience as a correlate of mood-smoking in everyday contexts.

Personality

Personality appears to influence most indices of smoking behaviour. Research suggests that there are systematic individual differences between smokers and non-smokers (Colby *et al.*, 2000), and that, even within the smoker sub-population, there is significant variability between-persons in levels of dependence (Dierker *et al.*, 2001), reasons for smoking (Piper *et al.*, 2004), and smoking-related experiences (Patton, Barnes, & Murray, 1997). Traits indicative of specific affective styles warrant particular attention in relation to smoking (Gilbert, 1995). For example, emotional instability and impulsivity have been associated with smoking motivation (Reuter & Netter, 2001; Hall *et al.*, 1991; Acton, 2003), and these traits are more generally theorised to moderate mood responses (Hepburn & Eysenck, 1989; Gray, 1987).

The influence of other stable factors/traits (such as dependence level and non-affective dimensions of personality) will also be considered in relation to smoking and mood-smoking patterns, but the principal focus is on emotionality in smoking behaviour.

1.1.2 Hypothetical model of motivation

Figure 1.1 presents a hypothetical model of the motivational relationships under investigation. Better specification of this model is a goal of the present research.

Figure 1.1

Potential model of episodic smoking motivation

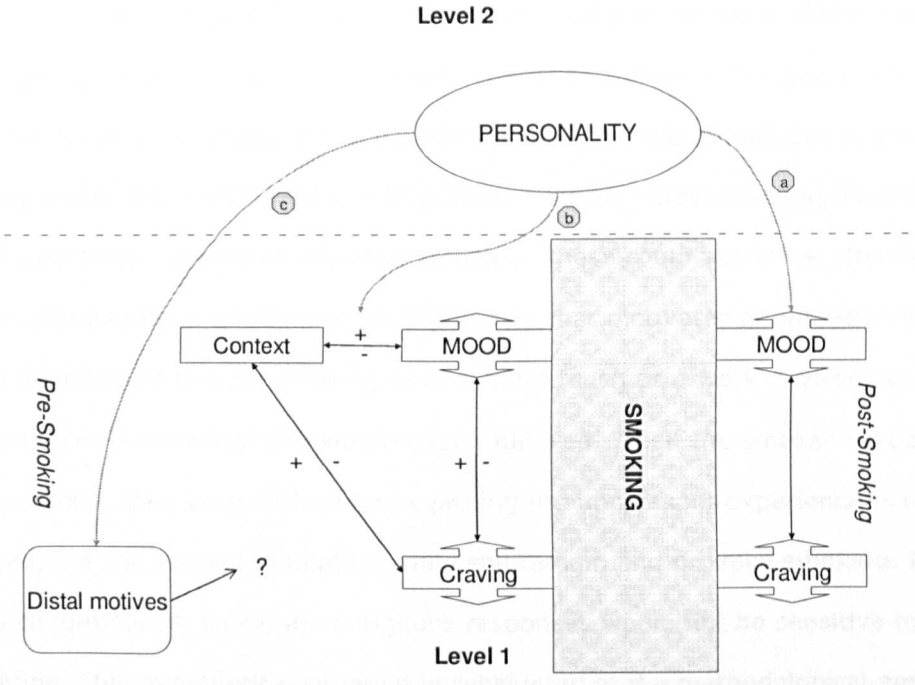


Figure 1.1 presents a model of motivational mood changes in relation to the onset and offset of smoking episodes; it further indicates that smoking-related changes might be influenced by personality (connection-type a). Personality is represented as being super-ordinate in a two-level hierarchy, where within-person relationships constitute the lower level of motivation. The model acknowledges that mood may interact with contemporaneous context and craving, and that these interactions may also be moderated by personality (connection-type b); as might the influence of more distal motives (connection-type c). The shaded box represents the duration of smoking; time is loosely conceptualised as advancing from left to right in this figure. Thus, variables shown to the left of the box depict pre-smoking state. Box arrows are indicative of potential changes in state (mood or craving) in connection with smoking.

The variable of central interest in this model is mood in relation to smoking. Mood changes from pre- to post-smoking reflect the direct effects of consumption, and changes before smoking (relative to baseline) reflect smoking cues and/or expectation (Rohsenow *et al.*, 1990-91). These mood changes may be sensitive to the context within which smoking occurs (Payne *et al.*, 1996); for example, effects of smoking consumption on mood may be different when in social situations or

when paired with alcohol. Reports of craving may represent metacognitions that reflect both mood cues and context (Toneatto, 1999), and this is indicated diagrammatically in Figure 1.1. Note that all pre- and post-smoking states could be inter-related, though all possible connections are not shown in the diagram (to minimise visual complexity). Though most states shown are contiguous to the smoking event, the model indicates that other motives – slower-acting processes lagged over time – may also influence smoking. These could also have affective content. For example, an unpleasant experience that motivates an intention to smoke might occur in a no-smoking environment (such as a work environment); circumstances dictate that smoking must be delayed. When the smoker is again able to smoke, their original feelings regarding the unpleasant experience may have subsided, but the smoking intention could still remain and provoke smoking. In such a circumstance, smoking-contiguous responses would not be sensitive to motivation. This hypothetical situation is considered in the methodological approach to the research: temporal assessment does not focus solely on the smoking episode - it also gauges associations lagged over the course of a day.

The relationships discussed above are within-person associations at level 1 of the hypothetical model. It may be that these associations are systematically moderated by personality traits at level 2 of the hierarchy: Personality may directly influence mood or influence its covariation with context (Gilbert & Gilbert, 1998); personality may further influence distal motives. The hierarchical model of motivation conceptualises the individual's experiences as being nested within their stable characteristics.

1.1.3 Plan of discussion

The introductory chapter begins by considering the constructs of mood and personality, and their potential implication in dependence processes. The scope of

the present research is limited to the investigation of mood, personality and dependence as they pertain to smoking behaviour – although natural consumption behaviour (eating) is examined using equivalent methods, so as to provide comparative appetitive data. Thus, the present chapter further provides a rationale for the research in terms of the importance of smoking as a health behaviour warranting further investigation - and evidence that smoking is a dependence-related activity. Subsequent sections consider mood and personality in relation to smoking behaviour. These sections provide an overview of relevant research to date, and introduce the conceptualisations to be applied in the present research, supporting the latter with the former. The final sections of the introduction provide a preliminary rationale and primer for the methodology utilised in the present research, they also outline the potential interactions of mood and personality in relation to smoking behaviour that will be tested and specify the key questions to be addressed by the research.

1.2 Mood, Personality, and Dependence

1.2.1 Mood

Affect is elusively multi-dimensional and can be defined along broad dimensions or more narrowly (prototype emotional states of sadness, anger etc.; Schimmack, 2001; Tomkins, 1992). There is no consensus definition of affect, but this does not necessarily impede the development of coherent research approaches to this area of experience (Kappas, 2002). After Darwin (1965), many researchers have adopted a functional conceptualisation of affect as a rapid response system – monitoring environmental opportunities/threats and modulating motivation accordingly – affording clear adaptive advantages (Ekman & Davidson, 1994). Affective responses are posited to reflect situational impact on the needs and goals of an individual, such that they are closely linked to motivation (Watson, 2000).

Affect includes physiological, behavioural, and cognitive aspects that may demonstrate complex interrelation. For example, physiological measures of activation (such as heart rate) may not be entirely consistent with self-reported affective experience (Levenson, 1992). Debate persists as to the dimensional make-up of affect, and how it might best be assessed (Niedenthal, Halberstadt, & Innes-Ker, 1999). This implies that mood measures selected for use in the present research may not be compatible with some theoretical approaches and/or reported study-outcomes. An attempt was made to assess self-reported mood as a multi-dimensional experience (discussed later in this section), with the potential for greater comparability and descriptive insight than might be afforded by assessments of fewer dimensions. However, it is acknowledged that the present approach - from its self-report method to the number and nature of affective dimensions applied – will not suit all positions.

Elements of affective response – including neural, sensorimotor, motivational, and cognitive processes – may be represented as a hierarchy of physiological and psychological dimensions (Izard, 1993). Affect is generated/represented at numerous neurological levels (Davidson, 1992). Cortical processing is not necessary for sub-cortical responses (for example, in the amygdala or hippocampus) to stimuli associated with emotion (LeDoux, 1996). Cortical structures are implicated in cognitive mediation of affective responses, conscious processing of affect, and the human capacity for reflective experiences of emotion (Quirk, 2001). Cortical and sub-cortical territories have mutual neurological projections suggesting systemic interactivity in the regulation of affect (Davidson, 1999). There is growing convergence in the literature on the notional existence of two fundamental systems underlying approach and avoidance-related emotion and motivation (Cacioppo & Gardner, 1999). The precise description of these systems differs somewhat across investigators, but there is consensus regarding the essential elements. The approach system has been described as facilitating appetitive behaviour and

generating particular types of affect that are approach-related, such as affect occurring as an organism moves closer toward a desired goal. Descriptions of the avoidance system suggest that it facilitates withdrawal from aversive stimulation and/or organises appropriate responses to cues of threat: generating avoidance-related affect such as anxiety (Gray, 1994). A variety of evidence indicates that these systems are implemented in partially separable circuits, primarily related to functioning of the prefrontal cortex and amygdale (Davidson & Irwin, 1999).

The present research methods dictate that only affective processes available to self-report will be assessed; it is important to recognise that measures applied in this research may be insensitive to some components of affect/arousal involved in the experiences under test, or sample them only indirectly. For the purposes of the present research, the terms affect, mood, and emotion will generally be used interchangeably. The DSM-IV (APA, 1995) defines mood as a more pervasive and sustained emotional "climate" in contrast to the fluctuating "weather" of affect (temporary expressions of emotion such as sadness or anger). However, these definitions have yet to be suitably operationalised (Matthews & Deary, 1998), and the distinction between acute changes in mood and changes that are less directly linked to immediate events will be more clearly demarcated by the temporal methodologies employed in the present research.

The present research applied the model of mood proposed by Matthews, Jones, & Chamberlain (1990) that comprises three main bipolar dimensions: hedonic tone (happy-depressed), energetic arousal (active-sluggish), and tense arousal (anxious-relaxed) – plus an additional unipolar dimension of anger. This model was chosen following recommendations to investigate mood-smoking relationships using conceptualisations of mood that incorporate aspects of arousal as well as affectivity (Kassel *et al.*, 2003). Comparative research further indicates that more common two-dimensional models of affect are not comprehensive enough to adequately

capture mood (Schimmack & Grob, 2000); a finding that additionally supports use of the Matthews *et al.* (1990) theory - and associated measures.

1.2.2 The subjective experience of mood

Given the focus of the present thesis on affective behaviour, and its investigative reliance on subjective self-report, it is important to acknowledge the limitations of conscious emotional experience. That which is available to self-report is secondary to more basic emotional responses (Rolls, 1999). These emotional responses form the primary response system: triggering actions prior to cognitive awareness of emotion/action (LeDoux, 1998; Zajonc, 2000). Such basic affective responses may largely be attributed to subcortical structures that evolved at an earlier stage than the human cortex, and were capable of producing appropriate responses to valenced stimuli without conscious feelings (as they are in species without higher cortical functioning; LeDoux, 1996). Even in the developmental cycle of a modern human, cognitive representation of emotional experience must emerge from these underlying responses (the reverse is not possible). Subjective reports of emotion can be informative about underlying processes, but conscious awareness is not necessary for emotional responding (Berridge, 2003).

For example, it has been shown that (conscious) affective reactions can be elicited by stimuli that are processed without conscious awareness (Bornstein, 1989). People show subjective hedonic preferences for repeatedly exposed neutral stimuli even when these stimuli are not recognised or judged more familiar (Kunst-Wilson & Zajonc, 1980). Similar effects of 'mere exposure' were found recently by Monahan, Murphy and Zajonc (2000): subliminally pre-exposed neutral stimuli elicited more positive subjective mood reports as compared with neutral stimuli that had not been presented before. Subliminal affective priming has also been shown for basic affective stimuli (human facial expressions; Murphy & Zajonc,

1993). Neutral stimuli (Chinese ideographs) preceded by subliminal displays of smiling faces were rated as more liked than neutral stimuli preceded by subliminal displays of frowning faces.

Thus, people may not be aware of the cues for the valenced emotions that motivate their behaviour. This suggests that the causes of affect-behaviour sequences might not be identified by subjective recall/insight. The present research applies event-sampling diary methods that could usefully elucidate situations surrounding affective behaviours. Contingencies that have not been explicitly identified by the participant may emerge from objective analysis of situational snapshots (elicited reports). However, evidence for unconscious elicitation of affect-behaviour sequences also suggests that cues could be missed by situational descriptions: even when these descriptions are not explicitly linked to affect/behaviour (i.e., participants are only asked to describe the situation they are in as they prepare to perform the behaviour under investigation), key details may be omitted. This could emerge from poverty of description or from genuine unawareness of the stimulus precipitating affect and behaviour (when the stimulus occurs outside conscious perception).

Discussion to this point has established that subjective reports may not capture the antecedents or triggers of an affective behaviour (such as smoking). Even if all internal and external states available to participant self-report are accurately recorded, there may be other cues for affect and behaviour that the participant is unable to report. This limits the insight into causal mechanisms that is achievable from self-report. Inference-making from self-reports relating to affective behaviour is further undermined by research that has established the operation of implicit emotion (Winkielman & Berridge, 2004): affect occurring outside of conscious awareness.

Berridge and Winkielman (2003) demonstrated that subliminal emotional stimuli (facial expressions) may prompt affective consumption behaviour without eliciting changes in subjective mood at the point of the affective reaction. In this way, both the cause and motivational state of emotion occurred outside of awareness, yet were powerful enough to influence behaviour. Clearly, this evidence has relevance for the investigation undertaken in the present thesis: it should not be assumed that affective experiences surrounding smoking behaviour will be available to self-report. All emotional states have the potential to become conscious (Ellis & Newton, 2000), and there are adaptive advantages to the entrance of these states into consciousness (Rolls, 1999), but such states may occur and affect behaviour without consciousness. It remains to be seen whether these unconscious states are only responsive to basic affective stimuli (such as human facial expressions) or whether secondary environmental stimuli (for example, the sight of a lighter for a smoker) and stimuli above the threshold of awareness can provoke unconscious reactions without conscious reactions (Winkielman & Berridge, 2004). Nonetheless, it is known that smokers subjectively recollect smoking to regulate their mood (Wetter *et al.*, 2004) and this suggests that measurement of conscious experiences of affect around smoking behaviour may be insightful.

1.2.3 Personality

The dominant approach in modern personality theory is trait theory (Matthews & Deary, 1998). In trait theories, people differ in amount of trait possessed on a continuum. There is a substantial body of evidence suggesting that personality traits remain stable over time (Costa & McCrae, 1992; Steyer, Schmitt & Eid, 1999). Trait concepts are couched in the everyday language of personality description and used to differentiate and generalise about individual behavioural styles. The scientific study of traits develops lay theories of personality by formalising these descriptors (Matthews, Deary, & Whiteman, 2003). Allport (1937)

shaped the theoretical development of trait psychology by formulating an argument for the use of common-sense terms in psychometric developments. Subsequent application of factor analytic techniques has led to the development of statistically validated self-report measures of personality (Segal & Coolidge, 2003). There is general agreement that dimensions of extraversion/introversion and neuroticism/emotional stability are fundamental elements of personality taxonomies (Eysenck, 1991; Pickering *et al.*, 1997; Costa & McCrae, 1992).

There is a consensus belief in the causal primacy of traits (Furnham & Heaven, 1999), and trait theories often posit links to putative biological mechanisms underlying individual differences (Eysenck, 1967; Carver & White, 1994; McCrae & Costa, 1996). However, others have argued that traits are constructions with no independent causal status – facilitating only description of natural categories of acts (Buss & Craik, 1983) – and evidence certainly questions the causal independence of traits (Hampson, 1988). Some researchers have circumvented the issue of causation, embracing the descriptive potential of trait measures and a more evidence based approach to conceptualising personality (Goldberg, 1993).

The present research applied a biologically-based, theoretically-driven measure of personality together with an exploratory lexical instrument. It was not in the scope of present research to determine which of these personality approaches (and related measures) is superior – although something might be learned about their relevance as applied to mood regulatory aspects of smoking. It was considered that the bio-theoretical measure would be particularly appropriate to the concept of reinforcement in smoking motivation, but that scoring on dimensions in the lexical measure would have descriptive utility (in fact, these dimensions can be interpreted within a number of relevant bio-theoretical accounts too; e.g., Costa & McCrae, 1992). Importantly, and in spite of their current dominance in the field, these personality theories have rarely been applied to smoking research. The measures

used, and the personality theory that guided present research, will be discussed later in the chapter.

1.2.4 Mood and personality

Since Galen's theory of humours (Stelmack & Stalikas, 1991), and its characterisation of temperament in the language of emotion (melancholic, choleric, phlegmatic, and sanguine), the notion of a fundamental link between personality and affectivity has persisted. Contemporary research has found that personality traits demonstrate strong correlations with affectivity (Matthews & Deary, 1998). The emergent correlational relationships may depend upon the conceptualisations and measurements of personality and affectivity adopted, but there are comparable consistencies that point to latent systemic processes. Evidence suggests, for example, that dimensional positive and negative affect (Watson *et al.*, 1994) - and comparable constructs of energetic and tense arousal (Thayer, 1996) – tend to be related to trait extraversion and neuroticism respectively. However, these relationships are modified by situational factors and might best be understood within an interactionist framework (Spielberger, 1986). For example, individuals higher in trait neuroticism may be prone to experience elevations of tense arousal (anxiety) at a higher frequency/intensity than their less neurotic counterparts, but an anxiety response may not occur unless certain situational conditions are in place – such as an external threat. The primacy (and independence) of personality in these interactions (personality-mood-situation) is perhaps somewhat inherent in its conceptualisation as the most stable component of the three behavioural correlates. However, Wells & Matthews (1994) describe a number of feedback mechanisms implicated in regulation/disturbance of personality, further to those affecting emotion. For example, dynamic interactions may be characterised by affective episodes (specific combinations of situation and emotion) that modify related personality traits - by feeding back to the very dimensions that pre-disposed the

affective episode. Endler (1993) is more radical in his depiction of the relative interplay of personality, mood, and situational factors: stressing the primacy of situation as determining appropriate personal-style and affective responses.

Clearly, there are gaps in our knowledge of these interactions that allow competing conceptualisations to arise. The chief implication of this for the present thesis is an affirmation of the need to look at these three components (personality, mood, and situation) simultaneously; acknowledging the potential importance of each and of their interaction. A further implication is the need for caution in interpretation. If a model shows, for example, that personality has direct effects on the mood-smoking relationship that do not vary across situations, the present methods would not allow conclusions to be made about the role of situations in personality development or the original/developmental direction of influence between mood-smoking and personality (prospective studies would be required).

1.2.5 Mood and personality in dependence

Research into specific motivations underlying dependence has only partly elucidated a phenomenon of evident complexity. Approaches that acknowledge the role of affective motivation and its relation to individual variability may help to address this situation (Gilbert & Gilbert, 1996). Eysenck's Drug Postulate model (Eysenck, 1963) was the earliest to specify a link between personality and state effects of psychoactive substances. Individual differences in extraversion formed the principal focus of Eysenck's theory, which posited a characterisation of extraversion as reflecting low cortical arousal and low sedation thresholds relative to introversion. Empirical findings have indicated that extraverts may exhibit greater affective reactivity to stimulant drugs, such as caffeine (Smith *et al.*, 1983). Claridge (1983) reviewed evidence supporting Eysenck's hypothesis, concluding in its favour, but stressing that extraversion interacts with other personality dimensions and

situational factors in predicting drug-related affect and associated responses. An individual's trait-based response tendencies may determine the key state-related motivations for their drug use across stages of initiation, maintenance, and relapse (Gilbert, 1994). For example, a person with a tendency towards depressed mood responses will experience greater depression during periods of drug abstinence such that drug use may come to be associated with the attenuation of depression.

For the purposes of the present research, smoking was investigated as a test-behaviour for potential relationships between personality, mood, and dependence. Methodologies applied in the present research might be particularly suited to examination of smoking behaviour, as animal modelling techniques – whilst successfully applied to opiate and cocaine use - have not been highly efficacious in capturing the smoking experience (Bozarth & Pudiak, 1996). Animals do not readily seek out nicotine (Dar & Frenk, 2002), requiring forced exposure to high doses to motivate marker behaviours for dependence. Furthermore, it may be that smoking behaviour is primarily related to activity of higher cortical functioning unique to humans – especially affective functioning in these regions (Davidson, 2001). Smoker sub-populations are also readily and openly available for sampling within clinically normal student populations. Thus, some of the ethical, legal, and practical barriers to conducting self-report into dependence may be circumnavigated by working with such a sample. The following section emphasises the importance of research into smoking by considering its public health consequences and the limitations of current understanding regarding motivations underlying smoking behaviour. Within this framework of discussion, the potential validity of smoking as representing a dependence-related process is also considered: such validity facilitates tentative generalisation of findings in smoking behaviour to other dependence behaviours.

1.3 Smoking

1.3.1 Smoking and health

Tobacco smoke contains numerous agents that are damaging to health (Benitez *et al.*, 1996) and smoking contributes to life threatening conditions such as heart disease, stroke, peptic ulcer disease, and lung cancer (Rose, 1996). In England, the prevalence of smoking among adults aged 16 and over has decreased from 40% in 1978, to 27% in 1998 (ONS, 2000). From a public health perspective, it is clearly important that smoking prevalence is reduced further still, with smoking-related costs to the NHS (in 1997 prices) estimated to be £1.4-1.5 billion (Parrot *et al.*, 1998). Over 120,000 deaths were caused by smoking in the UK in 1995 – a figure that accounts for one in five of all deaths that year (Callum, 1998) - and, globally, tobacco is responsible for more deaths than any other drug. It is estimated to be the cause of three million deaths a year, whereas the combined death toll causally linked to the use of alcohol and other psychoactive substances is closer to 123, 000 (WHO, 1997).

Smokers in the UK today have some knowledge of the negative health consequences of tobacco use – there is evidence to suggest that they might even overestimate the health risks of smoking (Viscusi, 1990). Health authorities and charities have done much to promote public awareness of the risks associated with smoking, and, in 1991, the government formally brought tobacco packaging health warning regulations in line with EU requirements (Tobacco Products Labelling (Safety) Regulations, 1991). Tellingly, survey data suggests that the majority of ongoing smokers – 69% (ONS, 2000) - want to quit smoking. Smokers are aware of the benefits of quitting, and statistical trends and cessation studies indicate that people *can* quit smoking, yet, clearly, smokers find it very difficult to stop – even when they want to. Smokers have little confidence in their ability to quit (Bridgewood *et al.*, 1996). In the UK, 30% of smokers try to quit each year (West

et al., 1999), but only 1% are successful (Jarvis, 1997), and it is evident that several quit attempts are often required before an individual permanently ceases smoking.

There is clearly scope for the development of effective interventions that can assist those who want to quit smoking. The present research contributes by characterising smoking associations in everyday situations – the contexts within which individuals have to cope during abstinence attempts. Moreover, the hierarchical approach of the present research acknowledges that smokers may vary in their motivation to smoke; evidence to this effect would support individualisation of treatment. Diary methods of the kind developed in the present research could be particularly efficacious in more individualised assessments.

1.3.2 Smoking and dependence

Evidence suggests that smokers become dependent on the nicotine present in tobacco smoke (APA, 1995; but see Atrens, 2001). It follows that nicotine-delivering tobacco preparations might be aptly categorised as addicting or dependence-producing drugs. Nicotine and smoking meet the criteria for substance dependence specified in both the ICD-10 and the DSM-IV (RCP, 2000). Garrett and Griffiths (2001) found that, in subjects with prior experience of cocaine and nicotine use, nicotine infusions produced dose-dependent increases in ratings of "drug effect" and "like drug"; seven of the nine subjects identified the highest dose of nicotine as cocaine. The DSM-IV defines drug dependence as: "...a cluster of cognitive, behavioural, and physiological symptoms that indicate that the person has impaired control of psychoactive substance use and continues use of the substance despite adverse consequences" (APA, 1995, p166). Typically, research has focused on the physiological component of nicotine dependence.

Animal research was the foundation for the study of neurochemical reward circuitry, and the better understanding of drug dependency it brought about, and there is a prominent tendency in the field to study substance use and related motivation within the framework of the derived dopamine (DA) theory (Wise, 1996) – which implicates the mesotelencephalic dopaminergic reward system in dependence. Available evidence from animal studies indicates that dopamine contributes in a discrete, but distinct, fashion to the nicotine cue (Di Chiara, 2000; discussed further in 1.3.3). This is not tested in the present research, but there have been notable efforts elsewhere to integrate subjective reports of mood and reward sensitivity (central measures in the current approach) with indices of dopaminergic functioning (e.g., Pickering & Gray, 1999).

Central to most definitions of reinforcement in physiological dependence is the idea that drug taking (as a reinforcing hedonic behaviour) moves the organism towards homeostasis whilst, simultaneously, the organism develops adaptive physiological mechanisms counteracting the effects of the substance. When substance use is extinguished abruptly, the now unopposed counteractive effects present the syndrome of physiological withdrawal (Schilit & Gomberg, 1991) – the symptoms of which may include agitation, difficulty concentrating, irritability, and sleep deprivation (effects opposite to the physiological experiences, and subjective correlates, associated with nicotine intake). The perception that dependence refers to a state of need for the continuation of drug consumption so as to prevent/relieve unpleasant withdrawal effects remains popular within the general public, but research indicates that acute nicotine withdrawal is not sufficient to explain dependent smoking behaviour (West & Gossop, 1994). Control of withdrawal symptoms through nicotine replacement therapy (NRT) is of limited efficacy - most smokers who are actively attempting cessation eventually relapse to tobacco products, even with the provision of alternative nicotine delivery systems (Rose, 1996) - and relapse can occur long after physiological withdrawal subsides (Somoza

et al., 1995). Sub-populations of regular smokers who show minimal signs of physical dependence (with negligible escalation in tolerance over time) have been identified (Shiffman *et al.*, 1994); these smokers do not experience acute physical withdrawal during abstinence – the maintenance of their smoking behaviour must be attributable to other factors – such as mood-regulation expectancies. This suggests the need for research into psychological reinforcement of smoking, as undertaken in the present thesis.

1.3.3 Pharmacology of nicotine

Discounting carcinogenic tars, nicotine is the only compound in tobacco possessing of pharmacological effects (Julien, 1997). Given that these effects are held to be instrumental in establishing and maintaining smoking dependence, discussion of the pharmacokinetics of nicotine is warranted.

Nicotine reaches the brain in a few seconds following smoke inhalation (principally through pulmonary absorption and via arterial blood), where it acts on 'nicotinic' cholinergic receptors. Activation of these receptors likely facilitates the release of dopamine from mesocorticolimbic neurons (Corrigall et al., 1994), and this mechanism of action accounts for the reward experienced by smokers (most clearly in early phases of use; Watkins et al., 2000): comprising mood elevation, appetite diminution, and cognitive enhancement (Stahl, 2000). The rapidity of nicotine's effects may in part account for its strength as a reinforcer (Quinn et al., 1997), especially as compared with forms of nicotine replacement delivery (Mathieu-Kia et al., 2002). At the end of each smoking episode, the blood level of nicotine rapidly peaks and falls; the elimination half-life of nicotine is approximately two hours (Julien, 1997). The falling nicotine levels between smoking episodes allow time for nicotinic receptors to re-sensitise somewhat between cigarettes (Balfour et al., 2000).

The reinforcing actions of nicotine show similarity to those associated with other psychomotor stimulants, such as cocaine. However, the effects of nicotine on psycho-pharmacology and behaviour appear more subtle than those of cocaine (Stahl, 2000). Where cocaine blocks dopamine transporters such that dopamine synapses are stimulated by a great flow of dopamine, nicotine may switch off nicotinic receptors after initial binding: such that the receptor cannot be stimulated for some time afterwards. In this way, dopaminergic stimulation from nicotine occurs in small bursts separated by gradual declines until nicotinic receptors turn on again (ready to be stimulated by the next inhalation of smoke or smoking episode). Thus, a certain amount of pacing is inherent in the effects of nicotine, potentially limiting its behavioural effects as compared with other psychomotor stimulants.

Dopamine has been identified as the key neurotransmitter in regulation of reward/pleasure reactivity (Wise 1996; Heimer et al. 1997) – although it may not be necessary or sufficient to produce subjective experiences of pleasure (Robinson & Berridge, 2001; despite correlational evidence; Volkow et al., 1999). Chronic nicotine administration may alter dopaminergic activity in the mesocorticolimbic system such that reward thresholds increase during periods of abstinence (Eissenberg, 2004). Thus withdrawal from nicotine could lead to a decrease in sensitivity to positive stimuli and depression of hedonic tone. Nicotine has a further property that may strengthen the likelihood of relapse (and, it follows, the strength of dependence) at this abstinent stage. Over time, nicotine users may sensitise their nicotinic cholinergic receptors to compensate for their being regularly shut down during smoking episodes (Stahl, 2000). A consequence of this in abstinence might be that the general anhedonia brought about by increased reward thresholds is compounded by a strong sensitivity to nicotine stimulation. In this context the rewarding value of nicotine to an organism may be particularly marked.

An understanding of the pharmacological basis of nicotine's effects bolsters interpretation of the subjective reports collected in the present research: providing a basis for linking reported experiences with knowledge of underlying mechanisms. Furthermore, it points to the importance of assessing smoking-related experiences within particular temporal windows and under particular conditions. The short-lived acute effects of smoking suggest the need to sample temporal points at close proximity to smoking episodes (event-contingent sampling). The gradual dissipation of nicotine levels between smoking events suggests that periodic reports may offer insight into slower-acting processes (fixed-interval sampling). Finally, the likely shifts in reward sensitivity and relative incentive value/direct effectiveness of nicotine during abstinence suggest that the effects of deprivation might be usefully examined.

1.4 Mood and Smoking

1.4.1 Previous research

Smokers believe that smoking may help to regulate their mood (Ikard *et al.*, 1969; Russell, Peto, & Patel, 1974; Spielberger, 1986) and many cite the perceived positive effects of smoking on mood as an important factor in their development and maintenance of smoking behaviour (Wetter *et al.*, 2004; Marsh & Mathieson, 1983). Regular smokers also report adverse moods – an increase in stress and irritability - when they have not recently smoked, and the mood-improvement attributed to smoking might represent a reversal of these effects (Parrott *et al.*, 1999). The implication remains that smokers may smoke in part to attain or avoid different feelings, and come to associate smoking with certain affective states and expectations of affective moderation. Leventhal and Cleary (1980) theorised that affectivity is central to smoking behaviour and that affective state may become conditional upon nicotine plasma level over time, more recent theories posit a link

between affectivity and smoking at a neuroregulatory level of explanation (Pomerleau & Pomerleau, 1984). Various motivational processes have been implicated in the development of mood-smoking mechanisms. Mood-smoking theories usually relate to one or more of the following causal frames: anticipation of euphoric effects of smoking (positive reinforcement; Glautier, 2004), alleviation of withdrawal symptoms (negative reinforcement; Eissenberg, 2004), and conditioning to stimuli that become associated with smoking (Carter & Tiffany, 1999). In the latter regard, mood may index motivational responses to other conditioned situational stimuli, and/or specific affective states may become conditioned cues for smoking (Gewirtz & Davis, 1998). The conditioned element has the potential to induce craving/smoking to both positive and negatively reinforced cues, and is generally considered reflective of a neural adaptation process (Nestler & Aghajanian, 1997). For example, cues associated with withdrawal might (potentially, long after withdrawal has subsided) trigger an associative neurochemical response that, in turn, produces symptoms of withdrawal (e.g., anxiety) causing the individual to seek relief in smoking (Halikas, 1997). During the maintenance phase of smoking it can be difficult to distinguish negative reinforcement involving withdrawal-induced mood (associated with nicotine plasma levels) from negative reinforcement involving mood responses to conditioned cues or other stressors.

It is emphasised that the methods applied in the present research cannot test whether identified associations result from conditioned associative mechanisms. However, a case might be made – based on prior experimental research – to suggest that state correlates of smoking could relate to smoking via such mechanisms. At minimum, the implications of associative mechanisms for present findings should be acknowledged. Clearly though, observed correlations (e.g., between being in a pub and increased positive mood before smoking) could reflect various causal sequences that may or may not represent associative learning.

Research implicating positive and negative reinforcement in mood-smoking motivational processes is considered below.

1.4.2 Positive reinforcement in mood and smoking

That smoking should have or be expected to have mood elevating (rewarding) properties is a common precondition for the development of both negative and positive reinforcement: mood from pre- to post-smoking should show improvement (although, as will be discussed below, some theorists argue that sensitivity to the direct effects of smoking may diminish after initial reinforcement). Nicotine is identified as having euphoric stimulant effects on affect and arousal (Garrett & Griffiths, 2001). Henningfield and colleagues (1985) demonstrated that a singular smoking episode may produce temporary elevation of mood. In support of positive reinforcement mechanisms, Tiffany and Drobes (1990) demonstrated that positive affect imagery induced urge to smoke in the laboratory - although negative affect imagery increased urge by a greater magnitude. Positive affectivity also precedes episodes of relapse (possibly reflecting reinforcement of positive affective cues for smoking); but it is present less frequently than negative affectivity (Shiffman *et al.*, 1996), and tends to occur concurrently with other cues to smoke (Brandon *et al.*, 1987). It may be that positive affect is more likely to index conditioning to different situational stimuli (such as the smell of smoke) than to become a separate/unique trigger in itself (i.e., irrespective of the underlying cause of positive affectivity).

To the extent that positive reinforcement is implicated in mood-smoking relationships, it is possible that incentive sensitisation processes may develop (Robinson & Berridge, 1993). Theoretically, repeated substance use sensitises the incentive properties of anticipatory cues whilst simultaneously producing tolerance to the direct effects of the substance. According to this framework, positive affect

might be involved in triggering smoking but come to be unresponsive to the previously rewarding effects of smoking. Much of the support for this theory of reinforcement has originated from research into other dependence behaviours, but, across these, motivational processes have been consistent (Robinson & Berridge, 2001). In relation to smoking, Zinser *et al.* (1999) reported increased positive affect in smokers when exposed to smoking cues, but not when permitted to smoke. Further evidence comes from nicotine's sensitising effects on dopamine release in the nucleus accumbens (Balfour, 2003): dopaminergic sensitisation is implicated in incentive sensitisation processes as it appears to reflect increased responsivity to anticipation of, rather than the direct effects of, reward (Robinson & Berridge, 2001).

1.4.3 Negative reinforcement in mood and smoking

Evidence suggests that negative affective states immediately precede more than half of reported relapses to smoking (Brandon *et al.*, 1987). Smokers consistently report that they smoke more frequently when sad, anxious, or angry – and anticipate that smoking will attenuate this negative affectivity – but these statements may not be valid reflections of the actual processes that occur (Kassel *et al.*, 2003). Such reports may be particularly prone to retrospective recall biases (Shiffman *et al.*, 2002). Negative affect-inducing manipulations have been shown to increase urge to smoke (in the absence of other cues; Tiffany & Drobes, 1990) and frequency/intensity of smoking (Payne *et al.*, 1991), although, again, these paradigms may not capture naturally occurring experiences (or typical subsequent responses). Further to reports of nicotine's antidepressant effects (Balfour, 1991), clinical trials have shown that antidepressant drugs (e.g., buproprion) can significantly increase smoking cessation rates in smokers (irrespective of their history of depression; Benowitz, 1997). Support for negative reinforcement in

mood-smoking relationships might be inferred from this evidence, although the underlying mechanism of action is not known.

1.4.4 Current standing and limitations of research to date

In review, Kassel *et al.* (2003) conclude that, although smokers and non-smokers differ in their baseline mood levels (e.g., Adan & Sanchez-Turet, 2000), it remains unclear as to what mood conditions might trigger smoking and whether smoking has any positive effects on affective state. Evidence suggests that the affective response elicited by smoking may be dependent on the situation within which smoking occurs (Gilbert, 1995). The ambiguity of findings to date has been largely attributed to methodological problems (Kalman, 2002). Studies have often failed to separate deprivation-reversal from genuine mood enhancement (West, 1993), resulting in a paucity of research examining normal mood-smoking relationships. Also, despite the evident influence of expectation to smoke on smoking-related responses (Dols *et al.*, 2002), many laboratory-based studies have measured affective responses to smoking cues when subjects were not permitted to smoke. Evidence suggests that withdrawal and cigarette availability may profoundly affect outcomes – and resultant theoretical implications. For example, negative reinforcement may only operate when smokers are in a deprived state (Parrott & Garnham, 1998) and/or smoking is obstructed (Tiffany, 1995); studies only sampling these conditions could over-estimate the role of negative mood motivation. In the few studies that have controlled deprivation and allowed participants to smoke, effects of cue exposure and consumption have generally been confounded (Glautier & Remington, 1995). Such an approach undermines theory-testing, because discrimination of different motivational theories necessitates separation of anticipatory and consummatory processes (Rohsenow *et al.*, 1990-91, Zinser *et al.*, 1999).

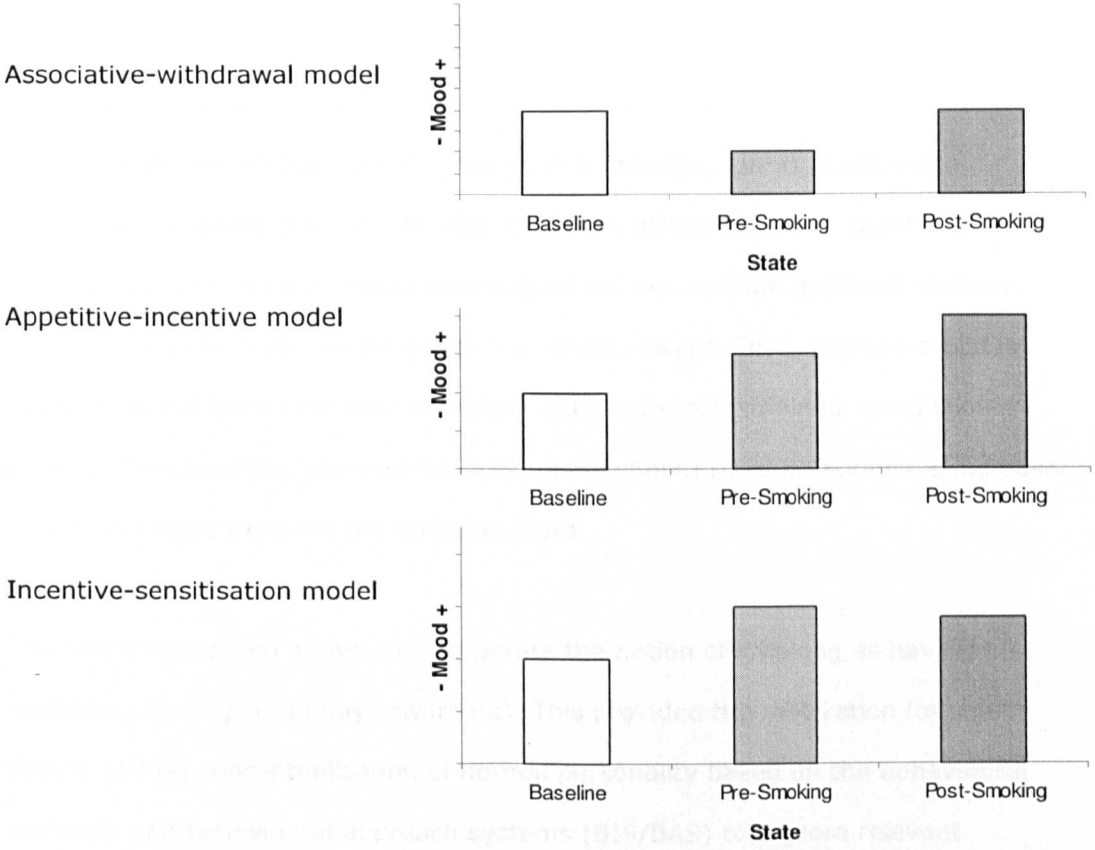
The major motivational theories that were compared in the present research - as they relate to mood regulation by smoking – are considered in the following sub-section. The application of these constructs will help to direct assessment of potential mechanisms in an area of psychological theory that is highly contentious.

1.4.5 Three models of mood regulation as a function of smoking

Three major theoretical models of drug motivation have emerged in the addiction literature, yielding distinct predictions regarding the effects of drug cues and consumption on affective state, these are: (1) the *associative-withdrawal* model, (2) the *appetitive-incentive* model, and (3) the *incentive-sensitisation* model (cf. Zinser *et al.,* 1999). Applied to the relationship between mood and smoking, these models facilitate specific predictions about mood change from baseline to pre-smoking, and from pre- to post-smoking state. These models and their predictions are described below. Figure 1.2 illustrates the distinct smoking-related predictions of the three models.

Figure 1.2

Predicted mood-smoking patterns by model



Associative-Withdrawal Model

Associative-withdrawal models (e.g., Wikler, 1980) posit that cues to smoke should elicit a conditioned mood response representative of nicotine withdrawal - increasing negative affectivity. Theoretically, the act of smoking will attenuate the negative mood produced by withdrawal/temporary deprivation. Thus, positive mood is expected to exhibit a U-shaped pattern of change: pre-smoking mood should decrease from baseline, and post-smoking mood should return to parity with baseline.

Appetitive-Incentive Model

Priming models (e.g., Wise, 1988) posit that both smoking and exposure to smoking cues should produce or prime a central motivational condition that

generates positive affect. Thus, positive mood is expected to exhibit a linear increase: pre-smoking mood should be greater than baseline and post-smoking mood should be additionally greater than pre-smoking mood.

Incentive-Sensitisation Model

The incentive-sensitisation model (Robinson & Berridge, 1993) posits that anticipatory smoking cues should output positive affect (as in the appetitive-incentive model), but that consumption itself will not activate approach systems – iterative drug use produces habituation to direct reward. Thus, positive mood is expected to exhibit an inverted-U pattern of change: pre-smoking mood should increase from baseline and post-smoking mood should show no additional increase/ a slight decrease from the pre-smoking state.

The models described above all incorporate the notion of smoking as having a reinforcing quality (primarily rewarding). This provided the motivation for using Gray's, (1994) conceptualisation of normal personality based on the behavioural inhibition and behavioural approach systems (BIS/BAS) to explore relevant moderation effects (discussed later in the chapter).

1.4.6 Other state correlates of smoking

It is important to acknowledge that mood-smoking relationships may interact in complex ways with other situational cues as part of broader associative mechanisms. Smokers are particularly susceptible to smoking when in the presence of stimuli related to previous smoking episodes (Carter & Tiffany, 1999; Wikler, 1965; Stewart, deWit & Eikelboom, 1984). Thus smoking is, in Pavlovian terms, the unconditioned stimulus, i.e., the food that makes the dog salivate. Like food, the behaviour/substance has another aspect independent of its direct reinforcing effects; it is transferred to other previously neutral stimuli to give them conditioned

reinforcement properties, i.e., the bell associated with the food that causes the Pavlovian dog to salivate. Affective processes may index reactivity to these cues, or mediate their effects on smoking and related motivation; it is further possible that some state-dependent smoking associations do not involve affective interactions (or, at least, do not involve consciously experienced affect/arousal assessable via self-report methods). The focus of the present research was thus broadened to investigate the role of these other correlates as they relate to smoking and mood regulation. This has not been done in other research to date.

Smoking may become associated with specific smoking-related cues (such as the visual perception of a lighter, or the smell of cigarette smoke; Piper *et al.*, 2004), and these cues can increase desire to smoke and smoking rate (Payne *et al.*, 1991). As smoking behaviour is repeatedly paired with different external stimuli (people, locations, and activities), these stimuli (non-specific to smoking) may also become powerful cues for craving and consumption (Childress *et al.*, 1999), and it is apparent that such cues might be very specific to the individual (Shadel *et al.*, 2001) – although general categories of potent triggers (such as social situations) that apply across individuals have been identified.

Smoking may become associated with the use of other substances such that consumption of (or exposure to substance-specific cues for) other substances may actually prompt smoking (Henningfield *et al.*, 1990). For example, administrations of heroin and amphetamine in the laboratory have been shown to increase participants' smoking rate (Mello *et al.*, 1980; Henningfield & Griffith, 1981). There is a well documented relationship between smoking and alcohol use (Miller & Gold, 1998). In the laboratory setting, drinking has been shown to increase the rate and amount of smoking among smokers (Mintz *et al.*, 1985), and exposure to drink cues increases urge to smoke among smoking-deprived alcoholics (Monti *et al.*,

1995). Those who smoke are more likely to progress to other drug dependencies than non-smokers (Henningfield *et al.*, 1990), and they have more severe substance abuse symptoms and other psychosocial problems (Roll *et al.*, 1996). Clearly poly-substance users may have a greater range of potential triggers to their smoking behaviour and craving, and dependencies may combine synergistically – understanding of cross-substance potentiation may have important treatment implications. The present research assessed alcohol consumption in relation to smoking so as to gain some insight into cross-substance associations.

Craving

One of the most prominent states common to ongoing smokers, smokers attempting cessation, and former smokers, is that of craving/desire to smoke (Tiffany *et al.*, 2000). The DSM IV (APA, 1995) describes craving as a "strong subjective drive" to use a substance, and it is this *subjectivity* of craving that makes definition of the phenomenon problematic (Halikas, 1997). Craving has been conceptualised as a metacognitive awareness of underlying states and cognitive-behavioural processes related to dependence behaviour (Tiffany, 1997). As such, reports of craving/desire to smoke may partly reflect higher order cognitive responses to affective and other state correlates of smoking (Toneatto, 1999a). It is anticipated that craving will be closely tied to mood: some researchers have even defined cravings as affective states (Baker *et al.*, 1987).

Craving may only show substantial relation to actual smoking behaviour when automatised action schemata (learned habits that become cognitively effortless – as could be implicated in mood-regulatory smoking) are impeded (Tiffany, 1995). Processes involved in consumption might operate independently of craving unless they require cognitively effortful support (e.g., when there are environmental obstacles to smoking) or are being blocked by a conscious attempt to abstain (attempts that demand conscious intervention between strong cues to smoke and

actual consumption). As might be expected of a metacognitive construct that potentially draws on various underlying processes, there are evident individual differences in the craving experience – including the perceived intensity of desire and of various affective components of craving (Merkle, 1999; Kozlowski *et al.*, 1989; Gossop *et al.*, 1990). Craving is thought to be particularly related to negative mood (Tiffany, 1992) – especially when cigarette availability is restricted (Sayette & Hufford, 1995). Whilst withdrawal symptomatology may inform craving - most clearly during periods of abstinence - it should be noted that clinical research indicates craving can be clearly demarcated from aspects of withdrawal. Ratings of drug craving form a separate construct from withdrawal (Mezinskis *et al.*, 1995) and NRT has been shown to produce minimal reductions in craving whilst almost completely attenuating withdrawal (e.g. Abelin *et al.*, 1989).

The potential involvement of craving and non-affective situational cues/correlates (occurring concurrently with smoking episodes or less proximally – perhaps through temporally lagged/cumulative relationships) provided the rationale for secondary measures incorporated in the present research. These were to include assessments of smoking episode context (time, location, activity, company, and acute craving intensity) and more generalised daily experiences (alcohol intake, exposure to passive smoke, distal craving levels, and salient positive/negative events). An initial questionnaire study will be carried out to assess contexts associated with smoking, and derived data will be used to design assessments for subsequent diary studies.

1.5 Personality and Smoking

1.5.1 Research to date

Individual differences in innate sensitivity to the effects of nicotine, personality, and psychopathology are all associated with affective experiences, and may pre-dispose

smoking and tendencies towards particular smoking-related experiences or behaviours (Kassel *et al.*, 2003).

Findings suggest that variability in emotional reactivity to nicotine and ancillary effects of smoking is an important factor in the early development of - and subsequent variability in - smoking behaviour (Pomerleau, Pomerleau, & Namenek, 1998). This variability may be systematically related to core affective dimensions of personality. For example, more extraverted individuals have been shown to experience greater elevation of positive affectivity and arousal from nicotine relative to their more introverted counterparts (Gilbert *et al.*, 1994). Individuals may also vary in their typically experienced affective context of smoking, and this might translate into susceptibility to different affective cues for abstinence lapses (Shiffman *et al.*, 1996).

Trait variability is related to smoker status such that there is evidence of identifiable personality differences between smokers and non-smokers. Adult smokers tended to be higher in psychoticism, (Patton, Barnes, & Murray, 1993). Similarly, users of tobacco have been found to have higher extraversion and neuroticism scores than non-users (Foreyt *et al.*, 1993). Longitudinal findings suggest that high neuroticism and psychoticism at an early age may predispose smoker status and greater severity of dependence (Canals, Blade, & Domenech, 1997): psychoticism was the best predictor in this regard. In terms of personality traits associated with smoking, there is particularly strong support for the role of characteristics associated with behavioural disinhibition: sensation-seeking and impulsivity (Acton, 2003).

Further evidence for a link between personality and smoking comes from the comorbidity of smoking and clinically diagnosed personality disorder. Glassman *et al.* (1990), analysing survey data from 3213 respondents, found that incidence of

major depression disorder in smokers was twice that found in non-smokers, and smokers with a history of depression are half as likely to succeed in quit attempts. Although depression is linked to smoking, it may not be associated with physiological dependence. Severity of depression has been found to be independent of smoking frequency and withdrawal intensity at abstinence (Hall *et al.*, 1993): relationships between depression and smoking instead suggest that individuals with depressive symptomatology are more sensitive to smoking-related mood enhancement (Kinnunen *et al.*, 1996) such that they might be more motivated to smoke as a means of regulating their dysphoric condition (motivational differences may exist where differences in dependence level do not). Childhood anxiety disorders predict relatively late onset of smoking (Costello *et al.*, 1999), but may accelerate development of dependence after initiation. This relationship might be considered a reminder that individual disposition can influence smoking behaviour through lifestyle choices as well as smoking response/development. High anxiety in childhood may impede involvement with peer groups of smokers (a typical precursor of individual smoking onset) until later in life, only after initiation would any link between trait-anxiety and tendencies towards mood-regulatory dependence become evident. Smoking may also be linked with attenuation of inattention in ADHD (Flory & Lynham, 2003).

Some research has indicated that gender may moderate dependence severity in smoking: finding that men tend to be heavier smokers than women (Giovino *et al.* 1994), with greater dependence on the direct effects of nicotine reinforcement (Perkins *et al.* 1999). It has further been suggested that there may exist a gender difference in smoking motivation such that affect regulation might be a more important function for women than men (Pomerleau *et al.*, 1994). However recent research reports that smoking-related motivational processes are similar across genders (Etter, Prokhorov, & Perneger, 2002). Nonetheless gender will be assessed

in the present research so as to examine its potential moderating influence on smoking motivation, and interaction with personality traits.

1.5.2 Current standing and limitations of research to date with reference to personality

In a systematic review of research since 1970, Gilbert (1995) found that the major affective dimensions of personality demonstrated inconsistent relationships with smoking behaviour. Approximately 49% of studies measuring neuroticism and 65% of studies measuring extraversion found smokers scored higher than non-smokers on assessments pertaining to these traits. Earlier research (reviewed by Smith, 1970) had suggested a more consistent relationship between extraversion and smoker status (supported in approximately 88% of studies), although a similar degree of inconsistency was found with regard to neuroticism (48%). Despite inconsistent relations with extraversion and neuroticism, Gilbert (1995) reports reliable associations between smoking and psychoticism – a trait that may share variance with extraversion in the moderation of impulsivity/sensation seeking (e.g., Eysenck & Eysenck, 1985; Gray, 1987).

The difficulty of establishing consistent relationships between personality and smoking-related behaviours/experiences is compounded by issues surrounding choice of conceptualisation and appropriate assessment (reviewed in Schinka, Haley, & Greene, 1997). Personality may moderate smoking behaviour in a complex manner mediated by situation and momentary processes (Gilbert & Gilbert, 1998), but much research to date has looked for links between personality and summary markers of dependence that may reflect underlying processes in a somewhat indirect and insensitive way. Limitations may lie in the level of analysis as much as the dependent variable of choice: the hierarchical nature of relationships between personality and behaviour/experience may be obscured by

statistical methods that examine such relationships at a single level (necessitating aggregation or disaggregation of variability). The interplay of stable dispositions and transient processes in smoking behaviour might best be revealed through the analysis of personality in relation to multiple real-time measures of experience: Shiffman *et al.* (1997a) showed that individual differences related to smoking behaviour were not apparent in static baseline measures of smoking behaviour/typology, but were revealed in relation to temporal smoking patterns.

The present research sought to apply conceptualisations (and relevant contemporary measures) of personality that have rarely been utilised in relation to smoking behaviour and mood-smoking patterns (despite clear theoretical links with these phenomena). Two of the dominant constructs in modern personality research are (1) five-dimension trait models (Goldberg, 1990) and (2) the biologically-based dual-affect systems of behavioural inhibition/activation (Gray, 1994). There is a paucity of research explicitly addressing smoking behaviour and mood in relation to these constructs. The methodological and analytical techniques operationalised in the present research were chosen so as to capture the potentially hierarchical and temporal nature of personality-based moderation of mood and smoking.

1.5.3 Applied conceptualisations of personality

BIS/BAS

It has been suggested that affective responses/motivational states are manifestations of two underlying brain-behavioural systems (Gray, 1990, 1994; Carver & White, 1994). The behavioural inhibition system (BIS) is sensitive to stimuli associated with punishment, and activation of this system generates affective responses that motivate avoidance behaviours (Gray, 1972, 1987). The behavioural approach system (BAS) is sensitive to stimuli associated with reward, and activation of this system generates affective responses that motivate pursuit

behaviours (Gray, 1972, 1987). If individual differences in affective response/motivational state reflect individual differences in BIS and BAS sensitivity, it is reasonable to expect that variability in smoking-related affect/motivation might be moderated by the same basic personality systems. However, what is the likely moderating influence of BIS/BAS on this relationship?

In theory, the BAS regulates reinforcement sensitivity (Gray, 1981), and it follows that the BAS would be expected to play a similar moderating role across models of smoking-related mood change (all three models are reinforcement based). More specifically, greater BAS sensitivity should dispose an individual to greater reinforcement sensitivity (Pickering & Gray, 2001) such that individuals with the highest levels of the BAS-related trait should manifest responses indicative of the strongest learning. For example, if the associative-withdrawal model is evident, higher-BAS individuals should show greater mood-detriment from baseline to pre-smoking, and greater mood-enhancement from pre- to post-smoking, as compared with lower-BAS individuals. Because the BIS and BAS are theorised to be distinct constructs in competition for exclusive control over behaviour - such that activation of one system inhibits the other (Pickering, 1997) - BIS sensitivity should not be related to mood-smoking associations.

That the BAS alone is implicated in the three (reinforcement-based) models of mood-smoking makes it possible to more precisely predict the specific dimensions of mood that the potential models might apply to. Carver's (2001) review of the relationship between specific dimensions of mood and BIS/BAS concluded that the BAS is primarily linked to bipolar dimensions of affect equivalent to hedonic tone and energetic arousal (Carver & Scheier, 1998). If this is the case, it is reasonable to expect that hedonic tone and energetic arousal will emerge as the key components of mood in the mood-smoking relationship – such that systematic patterns of smoking-related mood change, if evident, should be specifically indexed

by variability in hedonic tone and energetic arousal. It should be noted that the present research focuses on a conceptualisation of BIS/BAS that predates the recent revision by Gray and McNaughton (2000). This is because the scales used in the present research were developed on the basis of earlier theoretical specifications (Carver & White, 1994).

Big Five

Research on personality has historically seen a lack of consensus in characterising the broad trait dimensions that capture individual differences and describe the potential structure of personality. More recently, however, results from convergent factorial analyses have suggested that five factors may be sufficient to represent variability in general personality (Digman, 1996; Goldberg, 1990). In the context of this, it is perhaps surprising that researchers have generally failed to apply five factor models and measurements in research on personality and smoking. The emergent factors are collectively known as the Big Five and include: Surgency (S; high scores equate to being extraverted and vigorous), Agreeableness (A; high scores equate to being sympathetic and cooperative), Conscientiousness (C; high scores equate to being methodical and responsible), Emotional Stability (ES; high scores equate to being composed and low in neuroticism), Intellect (I; high scores equate to being imaginative and meditative). The Big Five (as conceptualised by Goldberg; Goldberg & Saucier, 1996) is based upon the lexical hypothesis: this hypothesis contends that the individual differences that are most salient and socially relevant will come to be encoded as terms in the natural language; ties to causal mechanisms are not considered to be of particular importance (Goldberg, 1993), although some researchers have attempted to ground related five factor models in biosocial theories (McCrae & Costa, 1996).

Factors of Emotional Stability and Surgency (resembling neuroticism and extraversion respectively) may represent particularly relevant factors for the study

of mood and mood regulation (Watson & Clark, 1992; Watson, Clark, & Tellegen, 1988). These factors should also contribute to the measurement of BIS/BAS sensitivity (Corr, 2004). The remaining factors are not related directly to emotional responding, and no specific predictions are made about their links with smoking and mood. However, Agreeableness and Conscientiousness may interact to reflect psychoticism (Eysenck, 1991) - a trait with consistent links to smoking, as described earlier - and Intellect has been show to relate inversely to nicotine dependence in one of the few studies to consider the five factor taxonomies in relation to smoking (Shadel *et al.*, 2000). These factors are included for exploratory purposes, as they might reflect cognitive-behavioural dispositions to certain smoking-related experiences, and may be indirectly related to situational affective responses.

It has been demonstrated that Agreeableness, Intellect and Conscientiousness all reflect affectivity to some extent: content analysis indicated that these dimensions (when assessed by the presently employed adjective descriptors; Goldberg, 1992) contained approximately 34%, 10%, and 9% affective variance respectively (Zillig *et al.*, 2002). Moreover, traits such as Intellect may modulate the role of affective disposition/generation, or predict observed smoking variance that may not be related to affective motivations. Where observed outcomes show little affective content or moderation, these traits may aid interpretation – pointing to the likely function of uncovered processes.

1.6 The Present Research

1.6.1 Methodological Rationale

A diary study design was considered most apt for implementation in the present research. Retrospective recall is highly prone to error and bias, yet clinical

practitioners and researchers rely almost exclusively on self-reported recall of past events. Evidence suggests that objective facts are better recalled than subjective states (Brewer, 1988); it follows that methods relying on recall in self-report might be useful for assessing, say, personal smoking history/behaviours (i.e., number of cigarettes smoked, brand smoked, etc), but they are less likely to accurately capture changes in mood and craving state associated with behaviour. Shiffman *et al* (1997b) tested the accuracy of recall from retrograde accounts of smoking lapse episodes in a group of recently-quit former smokers; participants' recall at 12 weeks post-monitoring was compared to their logged accounts of lapses and temptations, which were recorded in near-real time using an electronic diary. Lapse recall was poor, with average kappa agreement between the computer records and recall accounts ranging from .18-.27, and it was evident that retrospective accounts were biased by current smoking status. Retrospective reports might be better employed as a first-step in the development of targeted monitoring protocols: identifying key areas of concern for further assessment using diary methods. Retrospective reports were partly used in this way for the present research. The utilisation of diary designs has greater ecological validity for inferring causality without manipulation (time-series modelling) and for capturing temporal and individual variability which may be compromised in single-occasion/aggregation-based techniques (Chatfield, 1996). Collection and analysis of event-contingent temporal data might help to elucidate the mood-smoking relationship, which has proved difficult to determine, and give insight to the relative influence of negative/withdrawal versus positive/pleasurable symptoms and associations in craving and relapse.

Multilevel modelling will be used in the analysis of repeated-measures and time-series data collected for the research so as to separate the influence of internal and external cues, which have previously been confounded. Most data captured in psychological research can be conceptualised hierarchically; data is often clustered,

with "units" nested within "levels" - in longitudinal research, for example, a number of distinct observations are grouped within individuals. Hierarchical data can be problematic; people existing within hierarchies tend to be more alike than people randomly sampled from the population as a whole. Because individuals sampled from the same organisational structure share certain characteristics, observations based on these individuals cannot be fully independent. This violates the assumption of independence of observations that is common to most analytic techniques, and increases the probability that a spuriously significant result will be found. Traditional techniques further assume that all data is collected at the same level – prompting arguments between researchers over the 'correct' level of analysis for various data structures (Osborne, 2000). Hierarchical linear Modelling (HLM) is a particular regression technique that is designed to take into account the hierarchical structure of data (Bryk & Raudenbush, 1992). Advances in statistical theory and computing enabled researchers to explicitly model multilevel data structures, and computer software for such analytical applications is now widely accessible (Goldstein, 2003).

The methodology to be applied in the research is a key consideration; systematic examination of the associative mechanisms in nicotine craving has proven difficult, and the utilisation of the rigorous data gathering and analytical techniques proposed here is considered to be the way forward for gaining an understanding of the processes inherent in dependence. Before studies amenable to time-series and HLM techniques could be cultivated and implemented, however, exploratory data gathering and piloting was required to gain a preliminary understanding of associative patterns in the population of interest, elaborate possible design issues, and better specify the materials and procedural set-up required to adequately sample experiences. To this end, a self-report survey methodology is implemented in the initial study of the research.

1.6.2 Key issues in the research

Hierarchical model of mood-smoking regulation

The primary aim of the present research is to test potential models of smoking-related changes in mood and how these are moderated by personality (particularly the dual affect systems of BAS and BIS). Evidence suggests that this model will be better characterised if contextual associations are considered (Gilbert, 1997), so the present research will be extended to examine the role of everyday situations in the basic model. Moreover the present research will sample craving in relation to smoking-associated experiences: subjective craving experiences may relate to moods and context in complex ways. Examination of craving in everyday situations might aid comprehension of a motivationally-important construct that has eluded definition.

Distal/periodic motivation

The reinforcement models investigated in the present research pertain to motivational actions that occur contiguously to the smoking event. However, focus on experiences within such a narrow temporal window may neglect motivational processes that act more slowly/are suspended over time (Wheeler & Reis, 1991). Moreover, a purely episodic focus on smoking limits interpretation to momentary responses – essentially disregarding the possible influence of more distal factors that would be easier to predict and develop interventions for (Shiffman *et al.*, 1997a). As a response to these considerations, the present research will apply methods that capture variability at different levels of temporality (i.e., fixed-interval further to episodic assessments).

Relation to natural appetitive behaviour

Evidence suggests that smoking applies reinforcing influences through appetitive mechanisms for natural rewards, such as food and sex (Di Chiara *et al.* 1993;

Schultz 2000; Spanagel and Weiss 1999). Understanding of smoking reinforcement might be elaborated by comparisons to natural appetitive behaviours. Are smoking motivations distinct from natural reinforcement? If they are, these differences could be informative about maladaptive shifts in motivational mechanisms that are specifically associated with dependence. However, if they do not, then theories of a basic motivational equivalence across consumption behaviours are supported (Hunt & Matarazzo, 1970; Bozarth, 1990); with implications that undermine concepts of addiction as a "disease" (Heyman, 1996). Similarly, comparison of trait moderation across smoking and natural appetitive behaviours would reveal whether individual differences dispose general tendencies in consumption/motivation (or are more behaviour-specific in their influence). Given the broader context of reinforcement common to appetitive behaviours (Koob & Le Moal, 1997; Berridge & Robinson, 2001), comparative study of smoking in relation to natural rewards is encouraged (Grunberg & Cousino Klein, 1998).

The present research will examine eating behaviour in parallel to smoking behaviour, for comparative purposes. Table 1.1 compares these behaviours, indicating their suitability for comparison of this kind. Smoking episodes and eating episodes differ in length (smoking episodes are shorter) and heterogeneity of content (e.g., choice of food versus tobacco). However, the occurrence of both is clearly defined (centring on an oral consumption event). Importantly, there is evidence for similar learning processes and patterns of use between behaviours; indeed, research suggests that these behaviours may be somewhat interchangeable as motivational stimuli. Of central relevance to the present research, subjective experiences related to eating episodes may include mood modification and craving – and personality may influence disordered consumption behaviours in the same direction. It has been suggested that similar processes underlie eating regulation, dependence, and craving (Grunberg & Baum, 1985).

Table 1.1

Comparability of eating and smoking behaviours

Behavioural feature	Evidence for comparability across behaviours
Behavioural substitution	• Food consumption tends to increase following smoking cessation (Williamson *et al.*, 1991). Smoking inversely related to body weight and food consumption (Grunberg, 1990) • Theorised that eating and smoking are substitutable rewards (Ogden, 1994)
Consumption event	• Clearly defined episodes for both smoking and eating • Eating events longer than smoking events, but both have reinforcing actions early in episodes (Benowitz, 1990; Rogers, 1995) • Basic topographical similarity of hand-to-mouth behaviours (Bickel & Vuchinich, 2000) • Eating behaviours more heterogenous in content of consumption
Mood effects	• Pleasant effects of smoking rated as same magnitude of eating palatable food (Lower rating of derived pleasure than for alcohol, sex, and marijuana) (Warburton, 1988)
Conditioning	• Same cue-induction procedure used effectively for both smoking and palatable food in animals (Schroeder, Binzak & Kelley, 2001) • Similar learning processes (Wise, 1997; Robinson & Berridge, 1993)
Patterns of use	• Similar behavioural phases seen for eating as smoking: Attempted restraint, relapse, bingeing (Kaye, 1999)
Craving	• 83% of 1138 survey participants report food cravings (Weingarten & Elston, 1991) • Food cravings apply to most foods, but are most likely to be based on physiological appetite in normal population (Gibson & Desmond, 1999)
Personality	• Suggestion of common predisposition to eating disorders and severe substance dependence (Koob & Le Moal, 1997; Kaye, 1999)

Changes during deprivation

An important part of understanding smoking motivation involves knowledge of motivation during abstinence – with implications for preventing relapse in cessation attempts. Do the motivations that prompt normal smoking prompt lapses in the same manner? Or do opponent processes come to cue smoking during abstinence (e.g., Ternes, 1977), turning positive reinforcement during continued use into negative reinforcement whilst deprived? Deprivation may be especially motivationally complex (Carver, Meyer, & Antoni, 2000). Mood could be negatively

affected by acute withdrawal effects and restricted reward availability; yet smoking (lapsing) may also be perceived as a threat (failure) during attempted abstinence, such that approach and avoidance are conflicted.

The present research will extend its methodological approach to sample experiences during deprivation/lapse episodes.

1.6.3 Research programme

To examine the key issues considered in the previous section, and apply the methodological approach set out previously, three intensive diary studies will be implemented. Their specific design will be informed by findings of the initial survey study (see Chapter 3). The diaries will be designed to provide complimentary information such that data gathered from these studies can be variously combined to address the key issues of the research.

Smoking diary

This study will utilise a self-report diary method to investigate patterns of smoking behaviour within and between individuals. The self-report diary consists of repeated episodic (event-contingent) and fixed-interval assessments, designed to elucidate the internal and external context of smoking behaviours, and identify relationships between mood, craving, contextual cue exposure, and smoking behaviour. Hierarchical analysis of the self-report data will facilitate further examination of how differences between persons can mediate these relationships within persons. The event-contingent component of the diary method represents an approach to sampling the smoking experience that minimises retrospective recall error and assesses behaviour and relevant associations situated in natural context.

Eating diary

The major purpose of this study was to provide comparative consumption data against which to contrast previously captured smoking data. To this end, most assessment components were minimally adapted from those applied in the smoking diary, such that only the behaviour being assessed was meaningfully different. Comparison of results from the two studies facilitated discrimination of patterns of consumption that are moderated at the person-level from those that are behaviour-specific.

Quasi-interventional diary

This study utilised a self-report diary method to investigate patterns of smoking behaviour within and between individuals under two temporal conditions: a period recording normal behaviour (wherein the participant is encouraged not to alter their usual smoking patterns), and a period over which the participant is encouraged to abstain from smoking. The self-report diary tapped largely the same variability as the original smoking diary. The quasi-interventional within-subject condition, under which participants are encouraged to refrain from smoking, enabled examination of how experiences related to smoking behaviour in normal context might change during abstinence, giving insight to counteractive effects reported in cases of acute withdrawal and craving experiences (e.g., Wikler, 1986). Furthermore, between-persons analyses of behaviour under this condition permitted better understanding of person-level moderation of readiness to abstain (a concept that includes willingness to abstain and ability to abstain; Gilbert, 1995).

1.6.4 Chapter progression

The following three chapters detail the methods of the research. Chapter 2 presents the design and methodological rationale, and introduces participant samples. Chapter 3 describes the measures of stable variability (including validated

instruments) that were utilised in studies of the research. Chapter 4 reports the initial questionnaire study of the research and its implications for the development of subsequent diary designs; this chapter goes on to present the final diary designs and related procedures.

Results chapters (5-9) address the key issues discussed previously; combining data from different studies as appropriate. Table 1.2 sets out the sequence of chapters, their foci, and the sources of data used in relation to these foci.

Table 1.2

Results chapters and the studies that they draw upon

		Diary studies		
Chapter	Key Issue	Smoking	Eating	Quasi-intervention
5	Models of mood-smoking and episodic correlates	✓		✓
6	Moderating role of personality	✓		✓
7	Comparative consumption behaviour	✓	✓	
8	Periodic variability in craving and consumption	✓	✓	✓
9	Changes associated with abstinence			✓

1.6.5 Summary: Aims

Clearly, there are gaps and inconsistencies in the literature regarding smoking motivation and affective regulation. The present research takes a novel approach to examination of this issue: assessing relevant relationships between mood, context, and personality. Further, it is the first to test the major theoretical models of motivation as they apply to naturalistic smoking behaviour (again, taking into account state and trait influences on proposed basic mechanisms). The scope of the research also extends to comparative analyses of smoking and natural consumption. Previous research has not directly attempted to test whether motivational processes generalise across different appetitive behaviours.

To recap, the main aim of the thesis is to examine the role of affectivity in smoking behaviour – and do so as part of an approach that appreciates influences of contextual and individual variability. Chief among the questions that this thesis looks to address are the following.

1) Are everyday smoking episodes associated with mood alteration, and is this relationship influenced by situation and/or personality?

Sub-questions include: Which theoretical model of reward-seeking provides the best fit for episodic patterns of mood-smoking? Do individuals tend towards different models according to their personality?

2) Are there more distal/gradual processes (over the course of a day) that influence smoking rate and/or the desire to smoke?

Sub-questions include: Are cravings and smoking rate reliably associated over a fixed period of time? Potentially, cravings may mediate relationships between mood

and smoking, so questions relating to this experience are pertinent to the main aim of the thesis.

3) Do processes identified for smoking behaviour generalise to natural appetitive behaviour?

4) How do processes identified for normal smoking behaviour change during deprivation/abstinence?

Specific hypotheses pertaining to each of the central issues are presented in the appropriate chapters.

Chapter 2. Design & Participants

This chapter focuses on the research methodology: design, rationale, and participant selection. For the purposes of the present research, methods centred on the collection of naturalistic diary data. The current chapter considers the types of diary protocol used and the justification for their use. It further discusses the statistical approach to analysing the data from the diary designs. The following section presents a basic design statement and rationale for the use of this design in the present research. The design is elaborated in subsequent chapters that detail the specific variables used in each diary study. Similarly, the methodological rationale is developed further: beginning in the present chapter with more thorough discussion of the usefulness of diary methods and associated analytical techniques. The final section of this chapter introduces the research participants; detailing recruitment procedures and the relevant characteristics of each sample.

2.1 Methodological Approach

2.1.1 Design

The present approach to sampling smoking (and comparative natural consumption) experiences used a self-report diary methodology. The diaries consisted of repeated event-contingent assessments designed to elucidate situational contexts and subjective states associated with consumption (smoking/eating) episodes – obtaining reports of mood and craving immediately prior to, and after, each event. Studies further employed fixed-interval assessments to record experiences that were not contiguous to consumption events and examine their relationships with consumption frequency and craving over time (both within the same interval and lagged from one interval to the next). Diaries were completed over 48 hours - except the quasi-intervention study (completed over 72 hours). The quasi-

intervention study also differed from others in that it introduced a quasi-experimental condition: A 24-hour period of encouraged abstinence. The specific variables measured in both event-contingent and fixed-interval components of the diaries are discussed in Chapter 4. As part of a hierarchical approach to investigating appetitive behaviour and affective regulation, stable variability was also measured (for submission to multilevel modelling techniques). Chapter 3 describes the personality measures and baseline/screening assessments that were administered to this end, and the rationale for their use. These instruments were presented at intake in the diary studies that constituted the programme of research.

2.1.2 Rationale

To understand individual differences in levels of dependence, patterns of smoking, craving, and ability to abstain, it is important to refine the measurement of motivations involved in onset, maintenance, and relapse to smoking (Schmitz, Schneider, & Jarvik, 1997). Laboratory studies have uncovered important associations, but the artificiality of such environments, and indeed, of static sampling of temporally dynamic phenomena, can make modelling of the significant relationships difficult (e.g., Neisser, 1976). For example, it has proved difficult to characterise the affective impact of exposure to smoking cues (Halikas, 1997) and the direct effects of smoking (Meliska & Gilbert, 1991; Parrott, 1999). Despite the emergence of distinct theories positing the valence of cue-elicited mood and subsequent moderation by smoking (Wikler, 1980; Wise, 1988; Robinson & Berridge, 1993), research to date has produced equivocal results such that the pattern of smoking-related affect cannot be determined (Zinser *et al.*, 1999). Previous studies have mostly been carried out in laboratory settings where participants are exposed to artificial cues and are not permitted to smoke - manipulating their expectations in a way that may not fully reflect motivational

processes as they occur in everyday situations (Dols *et al.*, 2002). Furthermore, in instances where participants have been allowed to smoke, the effects of cue exposure/anticipation and actual ingestion have been confounded, with no separation of affect elicited by cued versus pharmacologic states (Glautier & Remington, 1995).

In their extensive review of the literature on mood and smoking, Kassel *et al* (2003) recommend a shift in methodological perspective, suggesting that within- and between-persons questions regarding smoking-mood associations could be answered on a real-time basis in the smoker's real world – through the application of event- and interval-contingent diary strategies. Similar recommendations have been made by other researchers who have looked at personality and mood as they relate to smoking behaviour (Shiffman *et al.*, 2001; Delfino *et al.*, 2001), and recent research in alcohol consumption has applied event- and interval-contingent assessment strategies to look at the relationship between daily experiences and drinking as moderated by trait dispositions (Mohr *et al.*, 2001). The present research programme investigated smoking behaviour in relation to personality and mood by using a combination of diary strategies (episodic and fixed-interval) and global assessment instruments (administered at intake to capture more stable trait characteristics).

Table 2.1 provides an overview of the designs for the diary studies of the present research. Rows 2 to 4 correspond to the three separate diary studies (smoking, eating, and quasi-intervention). Columns 2 to 5 correspond to different features of the diary design. Thus, entries in the "diary period" column simply state the length of monitoring in each study; remaining columns pertain to the three assessment components of the diary design. Measures in the initial assessment were administered to participants at intake/before diary monitoring. Measures in the

episodic assessment were completed by participants at the time of each smoking event (this component is also referred to as event-contingent assessment). Measures in the fixed-interval assessment were completed at allotted times over the course of monitoring (this component is also referred to as interval-contingent assessment). Chapters 3 and 4 discuss these measures in detail.

Table 2.1

Diary Designs Implemented in the Present Research

	Diary period	Initial assessment	Episodic assessment	Fixed-interval assessment
Smoking diary	48 hours.	Battery of personality instruments and baseline measures completed before diary period.	Measures of mood and craving immediately before and after each smoking episode. Situation and consumption also noted.	5 assessments. Recall of experiences since previous interval: cravings, affective perceptions, passive exposure, caffeine and alcohol consumption.
Eating diary	48 hours.	As above, but behaviour-specific measures adapted to eating.	As above, but applied to eating episodes.	As above but adapted to eating behaviour where appropriate.
Quasi-intervention diary	72 hours: 2 blocks of normal smoking (24 hours each) separated by a 24 hour abstinence period.	As in the smoking diary.	As in the smoking diary.	As in the smoking diary but 7 assessments. Additionally, current mood and craving measured at each assessment interval.

Diary designs offer numerous advantages in terms of ecological validity and sampling within-person processes over time (Stone & Shiffman, 1994; Chatfield, 1996). These advantages are tempered somewhat by the challenges of adopting diary methods; the difficulty of ensuring that participants do not adapt their normal behaviour for more convenient monitoring, and of ascertaining the accuracy of compliance information (Stone *et al.*, 2002), compounded by the questionable adequacy of self-report as an index of state (Tiffany, 1990).

2.2 Diary Methodology

Researchers in psychology have historically identified a need for approaches to capturing life experiences with greater realism than might be afforded by laboratory-based assessments, observer ratings, or single-time questionnaires (Scollon, Kim-Prieto, & Diener, 2003). In 1942, Gordon Allport stressed the importance of assessing "life as it is lived", suggesting that psychological knowledge begins with documentation of the "particulars of life" (Allport, 1942, p.56). Contemporary approaches to capturing life as it is lived draw on diary methodologies: ongoing experiences are examined by instruments that are used to elicit/document repeated self-reports (Reis & Gable, 2000). Diaries facilitate investigation of psychological processes within everyday situations, addressing the importance of understanding situational influences on behaviour (Funder, 2001).

For the present research programme, two types of diary design were employed: event-contingent (episodic) and fixed-interval (Wheeler & Reis, 1991; refer to Table 2.1). Event-contingent designs require the participant to provide reports at every instance of a pre-defined experience. In the present research, this design was implemented to record smoking (or eating) episodes as and when they occurred. This design was appropriate for its intended use (Bolger *et al.*, 2003): there was minimal ambiguity about triggering events (as these were specific classes of

behaviour) and event-based responses were not used to sample common experiences in such a way that over-generalisation might occur – rather, research questions centred on experiences directly related to sampled events (and compared these with baseline experiences). For example, smoking-contingent mood scores were used to examine mood changes in relation to smoking episodes (i.e., at atypical times) rather than to generate conclusions about average or typical mood levels.

Fixed-interval designs require the participant to provide reports at specific times each day, as part of a schedule of assessments. In the present research, this design was implemented to sample more generalised periodic experiences (potentially giving insight to motivational mechanisms that might be more distal from acute smoking-event variability). This design was deemed useful to capture slower-acting processes in accordance with recommendations that diary designs vary the specificity/periodicity of assessment (Wheeler & Reis, 1991). For example, relationships between salient events, urge to smoke, perceived stress, and smoking behaviour might be lagged or cumulative (Halikas, 1997), and the time series data generated by fixed-interval measures facilitates exploration of such relationships that would not be possible with static sampling techniques.

2.2.1 Advantages of diary methods

Some of the major advantages of diary methodologies are outlined below, and discussed in relation to the present research aims and diary protocols. Five important merits are considered: (1) contingency identification; (2) ecological validity; (3) examination of ideographic processes; (4) attenuation of memory biases; and (5) the convergence of multiple research methods.

Contingency identification

Diary methods permit examination of complex questions relating to behavioural contingencies (Scollon *et al.*, 2003). Covariation in stimulus conditions (external and internal states) and behavioural/psychological responses can be ably assessed by repeated direct-sampling of experiences across contexts.

In the present research, the application of event-contingent assessments allowed potential mood-smoking-mood contingencies to be investigated across numerous self-selected situations and (non-induced) fluctuations in internal state, potentially providing a stronger representation of relationships between moods and smoking than might be obtained from single-time/situation assessments. The implementation of separate pre- and post-smoking assessments further facilitated an understanding of the direction of mood-smoking relationships that might not be accessible from global reports. Again, these contingencies were assessed repeatedly across voluntary circumstances (in response to naturally occurring motivations to smoke) in a way that would be difficult to achieve in other designs capable of separating pre- and post-smoking recording. Diary items recording other contextual variables at the time of smoking (such as location and activity) had the potential to provide a more comprehensive specification of state contingencies and to identify contextual modifiers of mood-smoking patterns. Further, by considering these within-person associations as being related to stable individual differences, the present application of diary methods permits characterisation of personality in terms of behavioural signatures (Mischel & Schoda, 1995) - predictable patterns of responding to state contingencies.

Ecological validity

Diary methods can be utilised to validate theoretical concepts and empirical findings in everyday real-world settings (Stone & Shiffman, 1994). Experimental psychology has been criticised as being unrepresentative of settings outside of the laboratory,

such that conclusions based on experimental data may not be applicable to real-life phenomena (Neisser, 1976). However, the rationale for experimentation – testing of causal hypotheses – does not require demonstration that events actually arise in a given population (Mook, 1983): the artificiality of an experimental study (non-resemblance of phenomena of interest) may be of little importance if the processes that occur under experimentation have psychological realism (Aronson, Wilson, and Brewer, 1998) and the *theoretical* conclusions drawn have ecological validity (relate to a theory proposed to explain everyday occurrences; Chow, 1987).

The need for ecological validity should not be overstated then, but, in the present study, the application of diary methods permitted examination of existing theories of mood regulatory smoking within natural social contexts – reducing artefacts attributable to controlled settings and research processes (Stone & Shiffman, 1994). Particular issues relating to laboratory investigations of the present research questions may arise from artificial mood induction/cueing, restricted expectation to smoke, and/or perceived demands on smoking behaviour (Tiffany, 1992). Applied diary methods further facilitated exploration of actual patterns of smoking behaviour and related experiences, a descriptive exercise yielding information with potential to form a basis for theory development and model specification (Hinde, 1995). Research questions relating to personality processes in smoking behaviours might best be understood when situated in time and place: some researchers have emphasised the need for personality research to be contextualised (McAdams, 1995), and the present research applied online methods to reveal latent moderation of everyday mood-smoking patterns.

Examination of within-person processes

Questions concerning within-person processes are among the most challenging that are amenable to diary methods (Bolger, Davis, & Rafaeli, 2003). Diary methods do not limit the researcher to between-person investigations, and this is an important

advantage when covariation across conditions or occasions is of interest, and within-person correlations (with independence from between-person processes/dispositional effects) are most apt (Reis & Gable, 2000). An illustration of the independence of within-person and between-person levels of explanation in the covariation of mood was reported by Zelenski and Larsen (2000). They found that like-valenced emotions showed little tendency to occur together at a given moment (weak within-person correlations), but were highly related at trait level (strong between-person correlations of aggregated momentary data). For example, participants were rarely sad and afraid concurrently, but those who were sad a lot tended to be afraid a lot too. An important advantage of diary methods then is their sensitivity to variability in within-person processes over time and sampled situations; these within-person associations can also be analysed in relation to between-person variables (Scollon *et al.*, 2003).

Within the present research, diary methods were applied to look at within-person smoking-state processes, and multilevel modelling techniques (discussed below) were implemented to investigate the moderating effects of personality on these processes (examining variability at both within-person and between-person levels). The utilised methods permitted exploratory investigation of individual tendencies in coded mood-smoking experiences; such ideographic processes are often neglected, but can complement traditional nomothetic investigations (Lamiell, 1997). Finally, the temporal nature of behavioural processes can best be assessed using diary designs that record the sequencing of events and control for third variables by using participants as their own controls (Affleck *et al.*, 1999): the present research examined acute smoking-related processes (as change scores) and also modelled interval-contingent data over time (in terms of lagged relationships).

Attenuation of memory biases

Retrospective recall is highly prone to error and bias, and may undermine typical self-report protocols (Schwarz, Groves, & Schuman, 1998). Recall might be skewed towards events that have occurred more recently (Baddeley & Hitch, 1993), or that have greater salience (Wagenaar, 1986), and events may be reinterpreted to reflect general (perhaps implicit) beliefs (Ross, 1989) - such that actual patterns and fluctuations are masked in report. The issue of memory bias forms a major part of the rationale for applying diary methods in research (Stone, Shiffman, & DeVries, 1999). Diary methods, as a technique based on self report, may still be affected by distortions inherent in participant-as-observer protocols (Schwarz, 1999), but many biases of global recollections are minimised (Reis & Gable, 2000)

Evidence suggests that objective facts are better recalled than subjective states (Brewer, 1988); it follows that methods relying on recall in self-report might be useful for assessing, for example, personal smoking history/acts (i.e. number of cigarettes smoked), but they are less likely to accurately capture changes in mood or craving state associated with behaviour. Retrospections of affect are also particularly prone to state/availability biases, such that recall/summary reports of mood tend to mirror current mood (Stone *et al.*, 1993). Shiffman *et al.* (1997b) tested the accuracy of recall from retrograde accounts of smoking lapse episodes in a group of recently-quit former smokers; participants' recall at 12 weeks post-monitoring was compared to their logged accounts of lapses and temptations, which were recorded in near-real time using an electronic diary. Lapse recall was poor, with average kappa agreement between the computer records and recall accounts ranging from .18-.27, and it was evident that retrospective accounts were biased by current smoking status.

Multiple methods research approach

Diary methods answer a call for methodological triangulation - an investigatory convergence of diverse research strategies (Reis & Gable, 2000) - and can provide information complementary to more traditional research designs (Reis, 1994). Accurate descriptive diary-data may be used to identify core phenomena and develop theory (Kelley, 1997), but diary methods also have direct theoretical applications: in the identification of moderators/contingencies for basic processes, verification of mechanisms, and determination of the real-life applicability of competing theoretical predictions (Reis & Stiller, 1992). Causal inferences require experimental manipulations and random assignment – rarely achievable in naturalistic contexts – but diary methods afford investigation of phenomena under voluntary, self-determined conditions when other factors - that may not be expected, based on previous experimental research/theoretical predictions – might be influential (Brewer, 2000).

2.2.2 Disadvantages of diary methods

Despite the apparent benefits of diary-based methodologies, it is important to be aware of known issues and limitations. These are discussed below along with attempts to minimise such problems in the present research, where possible. Three potential disadvantages are considered: (1) protocol demands; (2) reactance and learning; and (3) personality biases - as effecting diary participation (volunteering, responding, and compliance).

Protocol demands

Difficulties may arise from the complexity/intensity of diary methods. Detailed training sessions are required to develop participants' understanding of the protocol. As appropriate, all participants in the present research received individual instruction on diary-use during their first meeting with the researcher. Another potential problem is that the high level of commitment demanded/burden of repeated reporting could overwhelm participants (inviting inattentiveness or non-compliance; Stone *et al.*, 1991). In the present research, the latter concern was mitigated somewhat by restricting the length of assessments (<2 minutes for event-contingent assessments and <5 minutes for fixed-interval assessments in piloting, n = 15). This necessitated a compromise in the depth of reporting, but multiple-items are not required for establishing reliability of diary-based assessments - this can be estimated from the aggregate of single items over time (Csikszentmihalyi & Larson, 1987).

Reactance and learning

The effects of diary-keeping on participant experiences have yet to be determined, but potential effects include reactance, habituation, elaboration of understanding, and entrainment (Bolger *et al.*, 2003). Reactance – changes in phenomena under study as a result of measurement – has been considered an inherent property of monitoring protocols, such that diary methods have been used as a tool for behavioural modification (Wheeler & Reis, 1991). Litt *et al.* (1998), in research with treated alcoholics, reported that, although most participants indicated greater awareness of monitored drinking behaviour, they did not exhibit behavioural reactivity as compared with a control group; however, Shapiro *et al.* (2002), in a diary study examining smoking-events, reported that smoking frequencies during diary-monitoring were lower than reported norms – suggesting that the intensive protocol may have had an inhibitory effect on smoking behaviour. Evidence for this potential threat to validity, and the more general problem of response decay (Reis

& Gable, 2000), provided the rationale for limiting the monitoring period to just 48 hours (72 hours in the abstinence study): shorter monitoring periods should limit the development of extensive behavioural adaptations and/or participatory fatigue. Encouragingly for the present research (with its focus on naturalistic mood-smoking patterns), there is evidence to suggest that the process of diary-keeping does not alter participants' affective experiences (Cerin *et al.*, 2001)

Participants' understanding of monitored constructs may change with repeated exposure to a diary questionnaire (Bolger *et al.*, 2003). Elaboration of understanding may develop – increased awareness of the sampled domain through self-monitoring and introspection – and this may facilitate encoding/retrieval of domain-relevant information. There is indirect evidence against this effect in the present domain: Shiffman *et al.* (1997b) found that retrospective recall of monitored smoking-related experiences was poor, despite diary-keeping procedures, and Thomas and Diener (1990) found that intensive momentary mood reporting (several times daily) did not have a greater effect on retrospective accuracy than end-of-day reporting. Although participants may not develop a more complex understanding of the studied domain, they may come to see their experiences in terms of the constructs measured in the diary through a process of entrainment. For example, measures in the present research may influence participants to be more cognisant of mood in relation to smoking, and to be less perceptive of other factors. To date, there is little evidence of this effect or other potential effects of diary-keeping: the present research follows recommendations to limit the frequency and depth/duration of diary assessments until research better characterises the relationship between diary methods and phenomena under investigation (Scollon *et al.*, 2003).

Personality biases

Finally, not enough is known about the effects of personality (or state) on response compliance/style (Bolger *et al.*, 2003; Reis & Gable, 2000). Indeed, the potentially burdensome and intrusive nature of diary methods might lead certain types of individuals to be over- or underrepresented at intake: the type of person who volunteers for the study, and remains motivated through to completion, may not be particularly representative of the population from which they are drawn (Scollon *et al.*, 2003). Because of this, caution is exercised in the generalisation of findings from the present research. Also, to attract participants with less intrinsic motivation to volunteer, and encourage completion, monetary incentives were offered (Lynn, 2001).

2.3 Statistical Methodology

The unique nature of data acquired from diary-based sampling should be addressed in the statistical methods applied (Reis & Gable, 2000). There are various key issues in this regard (Bolger *et al.*, 2003):

1) Within-person data points may violate assumptions of independence (common to most analytical techniques).
2) Interval-contingent observations may show serial dependence, such that more contiguous reports are more similar.
3) Traditional repeated-measure analyses are rendered inappropriate by the often large number of data points and person-to-person variability in data production (for example, more frequent smokers provided more event-contingent reports in the present research).
4) The potential presence of temporal patterns/cyclicity (particularly in interval-contingent data) suggests a need to consider more flexible modelling techniques.

There is a growing consensus among diary researchers that multilevel models, adapted to suit repeated-measures data, are apposite for the analysis of diary data (Bolger *et al.*, 2003; Reis & Gable, 2000).

A major advantage of multilevel models is that they allow concurrent estimation of within- and between-persons effects (Maas & Snijders, 2003); facilitating accurate examination of questions pertaining to potential moderating effects of personality on smoking-state relationships, and exploration of other between-within associations. In multilevel models, cross-level data can be represented in a way that addresses problems associated with techniques that assume data to be collected at a single level (requiring preliminary disaggregation or aggregation of scores; Osbourne, 2000). By separating variability hierarchically, multilevel models account for dependence of observations in nested data (such as repeated measures within individuals; Bryk & Raudenbush, 1992), and avoid inflated type one error probabilities associated with independence violations in standard statistical techniques (Hox, 1995). Similarly, autocorrelations in within-person error terms (serial dependencies) can be modelled, and associated biases corrected (Hox, 2002). Multilevel models can also handle large repeated-measure data-sets with an unbalanced number of data points per person, including missing data (Goldstein, 2003; Maas & Snijders, 2003). To study lagged effects as a means of addressing potentially bidirectional processes in fixed-interval measures, such as periodic stress and craving in the present research, analyses of temporal patterns is required. Lagged variables can be constructed at the within-persons level of analysis (time-series correlations) for each person and averaged to arrive at a between-person average, but multilevel modelling of this data would be more appropriate (Raudenbush & Bryk, 2002): individual variability is not lost (as it would be in aggregated coefficients) so between-person differences in average temporal patterns may be examined.

Reis and Gable (2000) suggest that multilevel modelling should become the "gold standard" for analysis of diary data (Reis & Gable, 2000, p.213), because of the advantages offered in information retrieval from large hierarchical data sets. In the present research Hierarchical Linear Modelling (HLM) was implemented for the multilevel analysis of collected diary-data. HLM is a particular regression technique that is designed to take into account the hierarchical structure of data (Bryk & Raudenbush, 1992; Hox, 1995; Bryk, Raudenbush, & Congdon, 1996).

2.4 Participants (diary-studies)

For all diary studies, participants were recruited from a student population through pan-media advertisements. The following sub-sections describe specific selection criteria and sample characteristics for each diary study in turn. Effective sample size in multilevel modelling is the number of level 2 units multiplied by observations at level 1 (Snijders & Bosker, 1999): presently, this equates to the number of participants multiplied by the number of reported smoking episodes/fixed-interval assessments. For example, a group of 40 participants completing 5 fixed assessments produces a total sample size of 200. In terms of guidelines for sample size in multilevel modelling, testing suggests that the number of units at level 2 is more important than the number at level 1 (Mok, 1995) and a general recommendation is that 30 or more units at level 2 should be sampled (Kreft, 1996).

Smoking diary

The sample consisted of 40 participants taken from a university population (mean age = 22, SD = 2.33, 41.9% male). Criteria for inclusion were reported smoking rate of at least five cigarettes a day and three months at the current rate, and not actively trying to quit smoking. These criteria aimed to ensure that there would be

multiple observations (at level 1) for each participant (level 2). Participants were paid £10 for participation.

The average age at which participants started to smoke was 15.6, and this appears to be consistent with national trends (ONS, 2002). Daily cigarette consumption during participants' heaviest smoking period was, on average, 17.9 cigarettes, but the majority of participants (58.5%) reported smoking less than 10 cigarettes a day at their current rate (which had a mean stability of 29.4 months). Mean dependence score on the Revised Tolerance Questionnaire (RTQ; Tate & Schmidt, 1993) was in the mid-range (2.9 on a scale from 1 to 5), indicating that nicotine dependence was not severe in the smoking diary sample. This was further reflected in participants' mean self-appraisal of the extent to which they are addicted to smoking, which was 6.1 on a scale ranging from 1 to 10. The mean smoking frequency observed during diary-monitoring in the present sample was 7.8 cigarettes per day, and this was lower than rates reported by participants during recruitment. Debriefing feedback suggests that this disparity was related to the inhibitory prospect of filling out event diaries on desire to smoke (an evident trend in such studies; Shapiro *et al.*, 2002), rather than a tendency to under-report actual smoking occurrences.

Eating diary

The sample consisted of 40 participants taken from a university population (mean age = 20, SD = 2.43, 17.5% male). The criteria for inclusion were non-smoker status, and not actively trying to diet. Non-smokers were selected so that smoker versus non-smoker comparisons could be made. Also, evidence for behavioural substitution between smoking and eating (see Table 1.1) suggested that consumption in a non-smoking group would provide a better comparison point (more likely to reflect natural patterns). Participants were paid £10 for participation.

The average Body Mass Index score was 20.9 (SD=2.37) and 72.5% of participants were in the normal range for their sex (20.7-26.4 for males, and 19.1-25.8 for females; Calle *et al.*, 1999). One male and one female were classed as marginally overweight, two males and five females were classed as underweight, and two females were classed as anorexic concerns. All participants received contact numbers for a local health centre and organisations promoting awareness of eating disorders. However, participants were informed that individual feedback/advice could not be given (as data was processed anonymously).

Quasi-intervention diary

The sample consisted of 30 participants taken from a university population (mean age = 23, SD = 2.57, 26.7% male). Criteria for inclusion were reported smoking rate of at least five cigarettes a day and three months at the current rate. Prospective participants were excluded if they had participated in the original smoking diary. Participants were recruited by pan-media advertisements, and were paid £15 for participation.

The average age at which participants started to smoke was 15.2, and this appears to be consistent with national trends (ONS, 2002). Daily cigarette consumption during participants' heaviest smoking period was, on average, 18.4 cigarettes, but the majority of participants (60.3%) reported smoking less than 10 cigarettes a day at their current rate (which had a mean stability of 32.1 months). Mean RTQ score (Tate & Schmidt, 1993) was in the mid-range (3.1 on a scale from 1 to 5), indicating that nicotine dependence was not severe in the present sample. This was further reflected in participants' mean self-appraisal of the extent to which they are addicted to smoking, which was 6.7 on a scale ranging from 1 to 10. The mean smoking frequency observed in the present sample (during diary-monitoring outside of the abstinence period) was 8.6 cigarettes per day, and this was lower than rates reported by participants during recruitment. Just over half of participants

(53.3%) managed to abstain completely during the abstinence period, and all but one smoked less during this period than in the pre-abstinence period. Only one participant continued full-abstinence after the encouraged period, but most (60%) smoked less than they had during pre-abstinence. The sample in the original smoking diary did not show a drop-off in smoking rate over the course of the monitoring period, so the reduced post-abstinence smoking-rate in the present sample might not be explained by response-fatigue. Debriefing reports suggested that some participants were keen not to return to their pre-abstinence smoking rate.

2.5 Next Chapter

Chapter 3 introduces the validated instruments selected for use in the initial assessments of the diary studies. These assessments provided the measures of stable individual variability that were examined as potential moderators of consumption-related experiences (data derived from diary responses). Validated mood and craving instruments were further used to establish baseline states, against which consumption-contiguous states could be compared. The initial measures are discussed in terms of their relevance for the present research and their relative merit over other measures that might have been implemented. Subsequently, Chapter 4 details the development of the episodic and interval-contingent diaries, and presents the diaries and study procedures as they were administered to participants.

Chapter 3. Initial assessment

This chapter discusses the measures selected for use in the initial-assessment component of the diary studies. Within the design of the diary studies, measures that constituted the initial assessment were given to participant to take away and complete before they began diary-based monitoring of their behaviour.

Initial assessments were administered to gauge stable individual variability, such that trait-based moderation of within-person experiences (smoking/eating motivation) could be modelled. Central measures in this regard were indices of the BIS/BAS since they were regarded as being particularly relevant to appetitive motivation. Secondary measures were the big five trait dimensions: it was considered useful to apply multiple personality assessments since the adopted BIS/BAS instrument (Carver & White, 1994) may not be the most sensitive measure of the theoretical constructs (BIS and BAS) under investigation (e.g., Acton, 2003). Where it is not clear what the best self-report instrument might be, use of multiple measures is encouraged (Corr, 2001). This multi-instrument approach was maintained across diaries (to maintain parity).

Other potential moderators examined were demographics and behaviour-specific tendencies (such as smoking dependence or attitudes to eating). These measures were mainly applied for descriptive purposes – to aid interpretation of motivation. For example, identifying whether a smoking-related mood change is moderated by dependence level would be informative about whether that experience is symptomatic of behavioural severity or common to all levels of use. Behaviour-specific measures would also serve a validatory purpose: it should be found, for example, that consumption frequency (in fixed-interval periods) is moderated by dependence. Validated mood and craving instruments were further used to tap baseline states, against which episodic states (pre- and post-consumption) could be

compared. These measures were completed twice before diary-monitoring commenced: once in the morning and once in the evening.

Examination of central questions in the present research draws on findings from three separate diary studies: the original smoker diary (Appendix A), an adaptation of the diary assessing eating as a comparative consumption-behaviour (Appendix B), and a quasi-interventional variant of the smoker diary designed to tap process changes over a period of encouraged abstinence (Appendix C). Following sections detail the applied measures in the initial assessments of these diary studies. The initial assessments for the smoking diary and quasi-interventional diary were the same in every respect. Therefore, measures for these diaries are considered together in the next section (*smoking diaries*). In the subsequent section, initial measures that were unique to the eating diary are discussed; these were substitute assessments for the smoking-specific measures in other diaries. Discussion of measures that were common across smoking and eating diaries (see Table 3.1) was not repeated in this section. Table 3.1 shows the validated measures applied in each diary protocol and internal consistency (Cronbach's alpha) of measures in each sample to which the measure was administered. These were generally satisfactory - although BAS Drive and reward responsiveness subscales were below the commonly applied cut-off point of .70 (Nunally, 1978) in the eating-diary sample.

Table 3.1

Validated instruments applied in diary studies and associated reliabilities

		Reliability (α)		
		Smoking Diary	Eating Diary	Quasi-intervention Diary
BIS-BAS	BIS	.74	.76	.77
	BAS-RR	.73	.63	.72
	BAS-DRV	.76	.55	.70
	BAS-FS	.66	.72	.74
B5	S	.83	.89	.85
	A	.64	.82	.80
	C	.77	.80	.82
	ES	.84	.86	.83
	I	.80	.78	.80
UMACL	EA	.83	.73	.80
	HT	.89	.72	.84
	TA	.75	.80	.77
	AF	.80	.88	.79
RTQ		.86		.79
QSU-Brief	(General score)	.92		.90
	Positive craving	.93		.91
	Negative craving	.85		.89
TFEQ	CR		.75	
	UE		.73	
	EE		.87	
HQ			.89	
QEU-Brief	(General score)		.92	
	Positive craving		.93	
	Negative craving		.80	

Legend
BIS = Behavioural Inhibition System; BAS = Behavioural Approach System:
RR = Reward Responsiveness, DRV = Drive, FS = Fun-Seeking
B5 = Big Five personality dimensions:
S = Surgency, A = Agreeableness, C = Conscientiousness, ES = Emotional Stability, I = Intellect
UMACL = UWIST Mood Adjective Checklist:
TA=Tense Arousal, HT=Hedonic Tone, EA=Energetic Arousal, AF=Anger/Frustration
RTQ = Revised Tolerance Questionnaire. QSU-Brief = Questionnaire on Smoking Urges
TFEQ = Three Factor Eating Questionnaire:
CR = Cognitive Restraint, UE = Uncontrolled Eating, EE = Emotional Eating
HQ = Hunger Questionnaire. QEU-Brief = Questionnaire on Eating Urges (adapted from QSU)

3.1 Smoking diaries

3.1.1 Socio-demographics

Age and gender were assessed.

3.1.2 Smoking-related history

Participants were asked to report the age at which they first smoked a cigarette, the length of time that they had been smoking at their current rate, the number of cigarettes that they consumed daily during their heaviest period of smoking, their current tobacco brand of choice, and the total number of serious attempts to quit smoking that they had made to date. These questions were derived from standard clinical assessments of smoking background/history (Rustin, 1991; Rustin & Tate, 1993).

3.1.3 Readiness to change

Three questions assessed participants' readiness to quit smoking. Participants indicated the extent of their desire to quit smoking, confidence in their ability to quit smoking, and perceived addiction to smoking on separate scales anchored at 1 = None and 10 = Very strong. Ratings of desire to quit and self efficacy (incorporating perceived dependence and self-confidence) have consistently been shown to be associated with readiness to change/predict future cessation attempts (Boudreaux *et al.*, 2005; Sanders *et al.*, 1993; Richmond, Kehoe, & Webster, 1993). The number of previous cessation attempts (grouped with the history measures above) is also an important measure in this regard (Marsh & Matheson, 1983).

3.1.4 Behavioural Inhibition/Behavioural Activation System scales

Dispositional motivational sensitivities were assessed using the Behavioural Inhibition/Behavioural Activation System Scales (BIS-BAS; Carver & White, 1994). The BIS-BAS is a 24-item self-report measure. The BAS scale assesses the tendency to experience strong positive affect or behavioural approach when cues of incentive are present. Three subscales constitute the BAS measurement: Fun Seeking, Reward Responsiveness, and Drive. The Fun-Seeking scale (BASFS) reflects both a desire for new rewards and a willingness to approach a potentially rewarding event impulsively. The Reward Responsiveness scale (BASRR) focuses on positive affective responses to the occurrence or anticipation of reward. Items of the Drive scale (BASDRV) pertain to the persistent pursuit of goals, regardless of whether these goals are inherently rewarding. In contrast to the BAS scale, the BIS scale is a unidimensional measure that assesses the tendency to experience strong negative affect or behavioural inhibition when cues of threat are present. The BIS/BAS was specifically developed to tap the basic BIS and BAS systems proposed by Gray (Carver & White, 1994). Personality instruments developed for other purposes could be applied to BIS/BAS assessment; for example, researchers could utilise EPQ Extraversion (Eysenck & Eysenck, 1975) as a measure of BAS, and the Manifest Anxiety Scale (MAS; Taylor, 1953) as a measure of BIS. However, the conceptual basis of the EPQ is fundamentally different from that of Gray's BAS, and the MAS assesses typical experiences rather than BIS/anxiety *sensitivity* – it is important to distinguish vulnerability from actual experiences, as individuals may learn to avoid situations that they are sensitive towards (Carver & White, 1994). The development and implementation of bespoke measures of motivational sensitivities (such as the BIS-BAS scales) has been recommended above adaptive-applications of existing trait conceptualisations (Corr, 1999). Across samples in the present research, the sub-scales of the BIS-BAS had quite reasonable internal consistency: BIS (α = .74), BASRR (α = .73), BASDRV (α = .76), BASFS (α = .66).

3.1.5 IPIP "Big Five"

Personality was assessed using the International Personality Item Pool (IPIP) "Big Five": an online version of Goldberg's (1999) 50-item inventory measuring the domain constructs of the Five Factor Model. The current dominant model in theory and research on trait-personality proposes that personality is best described in terms of a hierarchical model with five main domains (e.g. Goldberg, 1990). Participants rated the descriptive accuracy of statements about themselves, yielding scores for dimensions of: Surgency (S; high scores equate to being extraverted and vigorous), Agreeableness (A; high scores equate to being sympathetic and cooperative), Conscientiousness (C; high scores equate to being methodical and responsible), Emotional Stability (ES; high scores equate to being composed and relaxed), Intellect (I; high scores equate to being imaginative and meditative). The Big Five scales have shown acceptable reliability, and there have been (on the basis of correlations with self-reports of relevant behaviours) - encouraging indications of validity (Buchanan, Goldberg and Johnson, 1999). The short length of the 50-item IPIP modification adapted for use in the present study makes it appropriate for use in future studies which may require more intensive self-reporting; lengthy one-off assessments might deter potential participants already concerned about the burden of completing multiple repeated measures over time.

3.1.6 UWIST Mood Adjective Checklist

Mood state at the time of participation was assessed with the UWIST Mood Adjective Checklist (UMACL; Matthews, Jones & Chamberlain, 1990). The UMACL comprises three main bipolar scales – Hedonic Tone (HT: scored such that high scores equal high happiness), Energetic Arousal (EA: scored such that high scores equal high alertness), and Tense Arousal (TA: scored such that high scores equal high stress) – plus an additional monopolar Anger/Frustration scale (AF: scored

such that high scores equal high irritation). Participants rated 29 words descriptive of people's moods/feelings according to how indicative each word was of their own mood state at the time they were completing the measure. Ratings were made on a scale from 1 (*Definitely* descriptive of current mood state) to 4 (*Definitely Not* descriptive of current mood state) for each word. The UMACL has satisfactory predictive and discriminative validity (Matthews *et al.*, 1990); its scales are distinct from demographic variables and personality traits, but moderate trait-state correlations are evident (as appropriate, theoretically). Schimmack and Grob (2000) compared two- and three-dimensional models of affect and concluded that affect could not be reduced to two orthogonal dimensions without the loss of important information. They suggest that measures such as the UMACL be adopted over the two-dimensional measures that are dominant in the literature. The UMACL had advantages for application in the present domain: it captures distinct components of affectivity and arousal that have been confused in previous mood-smoking research (Kassel *et al.*, 2003), and the bipolar structure of its central dimensions may offer a more valid representation of BIS/BAS-moderated affectivity (Carver, 2001).

3.1.7 QSU-Brief

The QSU-brief (Cox, Tiffany, & Christen, 2001), a 10-item version of the 32-item Questionnaire of Smoking Urges (QSU; Tiffany & Drobes, 1991), was used to assess urge and craving to smoke. Items were rated on a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Consistent with the QSU, the QSU-brief yields a two-factor item structure for cigarette craving. Factor 1 items reflect a strong wish and intention to smoke, with smoking perceived as rewarding. Factor 2 items represent an urgent desire to smoke, with anticipation of relief from negative affect. The QSU-brief is highly reliable as a measure of global craving across laboratory and clinical settings (Cronbach's α =.93; Cox *et al.*, 2001), and QSU-

brief scores are highly correlated with scores obtained using the longer QSU (Taylor *et al.*, 2000). The QSU-brief provides a rapid assessment of craving, yet, like the 32-item QSU, it captures multidimensional features of craving, and generates a general craving score with excellent reliability over conventional single-item craving-ratings. The length of the original QSU makes it impractical for potential application in times-series research designs.

3.1.8 Revised Fagerstrom Tolerance Questionnaire

Severity of nicotine dependence was assessed using the 10-item self-report Revised Fagerstrom Tolerance Questionnaire (FTQ; Tate & Schmidt, 1993) – a revision of the Fagerstrom Test for Nicotine Dependence (FTND; Heatherton *et al.*, 1991) implemented in the previous study of the research. Items of the RTQ encompass number of cigarettes smoked, smoking topography, smoking to relieve nicotine withdrawal and difficulty in refraining from smoking. All items are scored on a 5-point scale from 1 to 5, an adaptation that yields more variance than items of the FTND. The RTQ has been found to have greater internal consistency (α = .83) than was previously reported for the FTND. Test-retest reliability was high for all items of the RTQ, although findings suggest that the total RTQ score is more stable over time than any single specific item (Tate & Schmidt, 1993). A single common factor was identified in factor analytic procedures, indicating that the RTQ measures a unidimensional underlying construct. Reported relationships between expired air carbon monoxide (CO) and RTQ scores demonstrate preliminary construct validity for the revised instrument.

3.2 Eating diary

The eating diary was designed to parallel the smoking diary; to this end, measures administered in the initial assessment replicated previously discussed measures

where possible (see Table 3.1, previously). Socio-demographics were gauged as before, and other smoking-specific measures were adapted or replaced with similar assessments. Of the applied instruments, the BIS/BAS, big five, and UMACL were constant measures, applied in the eating diary as they were in the smoking diaries.

3.2.1 Weight history

Participants were asked to report their current height and weight, lowest adult weight, highest weight, perceived ideal weight, and the total number of serious attempts to diet that they had made to date.

These measures were used to calculate Body Mass Index (BMI). The BMI is a widely used weight-for-height index (i.e., it gives a value of weight adjusted for height; Kuczmarski & Flegal, 2000). Although it cannot differentiate body composition (i.e., muscle from fat), it is a convenient and generally accepted indicator of weight control issues (Vague, 1991). The administered (adult) weight measures allowed calculation of current BMI, lowest BMI, highest BMI, and disparity between current and perceived ideal BMI. These indices of weight control history were examined as potential moderators of eating-related processes.

3.2.2 Readiness for dietary change

Three questions assessed participants' readiness for dietary change. Participants indicated the extent of their desire to diet, confidence in their ability to diet, and perceived addiction to snacking on separate scales anchored at 1 = None and 10 = Very strong. These measures provided parity with assessments of readiness to change as applied to smoking. Assessment of readiness to change has been shown to be a common process across habitual behaviours (Shaffer, 1997).

3.2.3 Three Factor Eating Questionnaire

The Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) was implemented in the diary study of food consumption to assess cognitive and behavioural components of eating behaviour. The TFEQ served as a domain-specific measure of individual variability with parallels to the RTQ in smoking. The TFEQ was developed for application in populations of obese dieters (Stunkard & Messick, 1985) but has mainly been used among persons of average weight (Stunkard & Wadden, 1990; Pirke & Laessle, 1993). The present study utilised the revised 18-item instrument (Karlsson *et al.*, 2000). This revision draws on the most efficient items from the original instrument, yielding a different factor structure that reportedly results in improved convergent and discriminant validity; its use is especially recommended in burdensome protocols such as the presently discussed. Item response formats in the revised TFEQ were converted from the original dichotomous categories to four-point scales – such an adaptation is likely to produce improved performance (Jenkinson *et al.*, 1999). The revised TFEQ encompasses three subscales, representative of the derived factor structure. Cognitive Restraint (CR) assesses intent and ability to restrict dietary intake and scores on this scale have been associated with differences in food intake (e.g., Westerterp *et al.*, 1998). Uncontrolled Eating (UE) assesses the tendency to experience overwhelming hunger and episodic binging, often in response to external cues. Emotional Eating (EE) assesses the tendency to eat in response to negative affect.

3.2.4 Hunger Questionnaire

The Hunger Questionnaire (HQ) consisted of four items probing hunger-state that have been used together repeatedly in previous research (Friedman, Ulrich & Mattes, 1999; Mattes & Friedman, 1993). The HQ was applied as a validated measure of hunger parallel to the QSU measure of urge to smoke (although without

an equivalent two-factor structure). Items were scored such that high scores reflected high desire to eat. All items have been shown to load onto a single factor with high internal consistency (Lowe *et al.*, 2000).

3.2.5 Questionnaire on Eating Urges

To further gain parity between smoking- and eating-related measures, an attempt was made to adapt the QSU to tap hunger/desire to eat in the present sample. This is because there is no existing measure of hunger that parallels the two-factor structure of urge state in the QSU. Original items were minimally altered to address food-related urges, and participant scores on these items were submitted to cluster analysis[1]. The aim of this analysis was to see whether items replicated the two factor groupings obtained in the original QSU and QSU-brief derivations (Tiffany & Drobes, 1990; Cox *et al.*, 2001). Replication of the original item groupings would produce one cluster of items 1, 3, 6, 7, and 10 (Factor 1, positive craving) and a second of items 2, 4, 5, 8, and 9 for (Factor 2, negative craving).

Hierarchical cluster analysis, using Euclidean distance and complete linkage (Aldenderfer & Blashfield, 1984), produced two clusters of five items. Table 3.2 shows cluster membership for each item. Items 1, 3, 6, 7, and 10 emerged within the first cluster, supporting the hypothesised structure derived from the QSU Factor 1. Items 2, 4, 5, 8, and 9 emerged within the second cluster, supporting the hypothesised structure derived from the QSU Factor 2. The QEU Factors 1 and 2 yielded strong internal consistency coefficients (α=.93, .80 respectively). When the 10 items were used as a single global measure of urge to eat, the QEU adaptation showed very good reliability (α =.92). To the extent that the two derived factors reflect dimensions in the original QSU: Factor 1 items reflect a strong wish and

[1] Cluster analysis results are reported here due to the sample size being sub-optimum for factor analysis. However, the same structure was found using (unreported) factor analysis.

intention to eat, with food perceived as rewarding, and Factor 2 items represent an urgent desire to eat, with anticipation of relief from negative affect.

Table 3.2

Cluster-structure of QEU-Brief adaptation in the eating diary

Item		Cluster
1	I have a desire to eat right now	1
2	Nothing would be better than eating something right now	2
3	If it were possible, I probably would eat now	1
4	I could control things better right now if I could eat	2
5	All I want right now is something to eat	2
6	I have an urge for something to eat	1
7	Eating would be enjoyable right now	1
8	I would do almost anything for some food right now	2
9	Eating would make me less depressed	2
10	I am going to eat as soon as possible	1

3.3 Next chapter

Chapter 4 describes the initial questionnaire study and its implications for the development of the episodic and interval-contingent diaries. The chapter subsequently presents the diaries and related procedures as they were administered to participants. The chapter concludes by considering the issue of diary compliance and attempts to address this issue within the developed diary designs.

Chapter 4. Survey and diary development

Before diary studies amenable to HLM techniques could be developed and implemented, exploratory data gathering and piloting was required to gain a preliminary understanding of associative patterns in the population of interest, elaborate possible design issues, and better specify the materials and procedural set-up required to adequately sample experiences.

The present chapter details the development of the diary materials. It begins by reporting the initial survey study of the research. The results of this study were used to finalise designs for the event-contingent and fixed-interval smoking diaries. Section 2.2 presents and describes the finished design; this section also considers how the original design was adapted for the quasi-intervention and eating diaries. The final section in this chapter discusses compliance to the diary protocols that were administered. Compliance is a major issue in the use of diary designs (Stone *et al.*, 1991), and this section considers how the diaries developed in the present research attempted to control for this potential problem.

4.1 Questionnaire study

The initial study of the research took the form of an exploratory examination of smoking, contributing towards the identification of sensitive measures of internal state and common contextual correlates of smoking behaviour. Findings from the initial study were to be used to develop and refine materials for planned studies utilising self-report diary measures. To this end, measures of mood and craving were administered in the initial study to determine the most sensitive items for assessing relevant constructs in the present population; derived items were to be implemented as multi-recording, monitoring instruments in the developed diary assessments. By collecting qualitative data about the range of typical contexts

surrounding smoking behaviour and desire to smoke, the initial study crucially facilitated the design of a concise experiential diary that would lend itself readily to quantitative analysis in future applications. Qualitative research enables access to information not amenable to quantitative research, and it is considered by some researchers to be a prerequisite of good quantitative research (Pope & Mays, 1995), especially in the investigation of experiences as ill-defined as smoking-related experiences. Descriptive analysis of the initial survey data was further considered a useful introduction to the student-smoker sub-population (particularly their smoker characteristics), serving as a primer for the application of more rigorous measures and techniques in the diary studies to follow, and uncovering trends and tendencies that might warrant further investigation.

In summary, the main objective of the initial study was to develop appropriate and concise diary materials based on participants' responses to the questions and measures presented. Principal outcomes in this regard were situations, moods, and cognitions that respondents associated with their smoking behaviour. These associations could represent conditioned cues for smoking/craving, but participants are not asked to articulate such a connection (associative cueing may be outside of conscious awareness). Rather, participants were simply prompted to recall states surrounding smoking; the principal aim being to reflect common responses in the item-specification of developed diary materials.

Hypotheses

Though the present questionnaire used open questions to probe smoking-related experiences (as befitting its exploratory purpose) some general hypotheses may be generated. In terms of situations (locations, activities, and social contexts) associated with smoking, previous research guided expectations. Situations reported in connection with smoking are likely to include social contexts, alcohol, coffee, and after eating (Schmitz *et al.*, 1997). It was also expected that sensory

smoking associations – for example, the smell of tobacco smoke – would emerge in participant reports. It has been demonstrated that enjoyment of smoking is reduced when concomitant sensory phenomena are blocked (e.g., Baldinger *et al.*, 1995). An additional prediction - relating to temporal context - was that smoking would not be reported as an activity occurring early in the day. This expectation followed from the observation at intake that participants had a low-level of dependence (on average): morning smoking is a symptom of severe dependence (Fagerstrom, 1978).

In terms of moods that respondents would associate with smoking, it was expected that all the measured mood dimensions would be represented in recall: the literature shows that smokers have variously cited extremes of hedonic tone, tense arousal, energetic arousal, and anger as states that can motivate smoking (Gilbert, 1995). Indications are that tense arousal (stress) would be the most frequently cited motivation in retrospective reporting (Spielberger, 1986; Pomerleau & Pomerleau, 1991) – perhaps in part due to the salience of negative experiences in recall (e.g., Kensinger & Corkin, 2003). However, it is reiterated that recalled motivations should not be assumed to be accurate markers of actual experiences. One-off measures of affective smoking motivation have indicated trends that did not manifest in follow-up studies using prospective-longitudinal and diary-monitoring designs (Shiffman & Prange, 1988; Tate & Stanton, 1990). In terms of smoking-related cognitions, it was anticipated that smoking thoughts would relate to positive desires more than urgent needs; positive craving is more typical, especially in low-dependence smokers (Tiffany & Drobes, 1991).

4.2 Methods

4.2.1 Participants

The sample consisted of 139 participants taken from the population of the University of Nottingham (mean age = 24, 35% male). Participants could be either current or former smokers, and 27% of participants were former smokers. Nearly a third of participants classed themselves as social/occasional smokers (n = 44); 40.5% of former smokers, and 28.4% of current smokers. 43.9% of the sample consume, or used to consume, more than 10 cigarettes per day, and this consumption rate is notably lower than the national average (71%; ONS, 2000). Participants were volunteers, and selection was not based on any other inclusion/exclusion criteria.

4.2.2 Procedure

Participants consenting to take part in the study provided a few details of their history as smokers before answering a series of exploratory open questions about the internal and external stimuli and states that they associate with smoking. Participants then completed a series of tests designed to assess their level of nicotine dependence, mood, and current craving level. After completion of these measures participants were given the opportunity to ask any further questions about the purpose and design of the study. They were also given the opportunity to withdraw their responses from further analysis if they so wished. All participants received a Quit-line sheet providing contact numbers for organisations offering advice on smoking cessation.

4.2.3 Measures

Copies of all the measures administered, as presented to participants, can be found in Appendix D.

Socio-demographics

Age and gender were assessed.

Smoking-related history

Participants were asked how old they were when they first smoked a cigarette, how long they had been smoking at their current rate (current smokers only), how many cigarettes they consumed daily during their heaviest period of smoking, and how long it had been since they had smoked a cigarette.

Smoking associations

Potential triggers associated with smoking behaviour and desire to smoke were assessed with seven open-ended questions: (1) "Who are/were you usually with when smoking?" (2) "Where do/did you usually smoke?" (3) "When do/did you usually smoke?" (4) "What do/did you usually do while smoking?" (5) "What other things (e.g. specific sights, smells, and tastes) or events do/did you associate with smoking?" (6) "What are/were your thoughts just before smoking?" (7) "What are/were your feelings just before smoking? (Can you think of specific feelings that you associate with a desire to smoke?)". The final two questions were designed to identify internal triggers to smoking and the rest prompted structured recall of external triggers to smoking. Further to the open questions, a checklist of trigger situations (based upon findings in the literature and diagnostic materials; Rustin, 1991) was presented to aid and elaborate trigger recall; participants ticked boxes to indicate the situations in which they would usually smoke.

UWIST Mood Adjective Checklist

In the present sample, the UMACL (used to assess current mood at the time of questionnaire completion) demonstrated quite good internal validity: HT (α = .85), EA (α = .80), TA (α = .77), AF (α = .72). See Chapter 3 for further description of this measure.

QSU-Brief

Internal consistency of the QSU and sub-factors (used to assess current craving at the time of questionnaire completion) was good in the present sample: QSU Total (α= .94), QSU Factor 1 (α= .93), QSU Factor 2 (α= .89). See Chapter 3 for further description of this measure.

Fagerstrom Test for Nicotine Dependence

Severity of tobacco dependence was assessed using the 6-item self-report Fagerstrom Test for Nicotine Dependence (FTND; Heatherton *et al.*, 1991) - a revision of the Fagerstrom Tolerance Questionnaire (FTQ; Fagerstrom, 1978). The original 8-item FTQ was popular for years, gaining widespread use in clinical and research applications. Fagerstrom & Schneider (1989) reviewed research on the FTQ and concluded that the scale consistently predicted physical dependence, severity of withdrawal symptoms, and relapse. The revised FTND has greater homogeneity than the earlier version, improved reliability (α =.61), and evident validity (Heatherton *et al.*, 1991) – whilst retaining the predictive utility and popularity of the FTQ. Higher scores on the FTND are indicative of more intense physical dependence on nicotine and predictive of more severe withdrawal symptoms post-cessation. The FTND demonstrated better than previously established reliability in the present survey study (α = .79).

4.2.4 Data analyses

Content analysis

Responses to the exploratory open questions were categorised and analysed to ascertain the most frequent external situations associated with smoking, with the aim of developing appropriate categorised alternatives for context specification in the episodic smoking diary. Responses to open questions regarding internal triggers were also categorised and analysed, so as to facilitate statistical examination of different trends in mood-regulation smoking and in dimensional cognitive craving. Towards the specification of external trigger situations, it was pre-decided that responses be organised into categories representing company, location and activity; the structure of the open questions was such that responses to questions 1, 2, and 4 mapped directly into these respective categories. Frequencies of novel semantic responses in each category were counted; responses which were synonyms and close conceptual relations of more typical lexical items/concepts were subsumed accordingly for the purposes of the frequency count. An independent judge checked that responses had been grouped appropriately, and agreement between the researcher and judge was 100 percent for response groupings in all three categories. Response frequencies in the category of activity were only counted for novel items not included in the trigger checklist, frequencies for activities listed in the trigger checklist were determined from dichotomous responses to the checklist as it was felt that lexical response productivity for common activities might be low (as compared with actual occurrences). Some common activities might have become habitual, and, consequently, have reduced salience in memory (e.g. Wagenaar, 1986) - affecting the representational quality of open recall (but not cued recall as elicited by the checklist).

Responses to question 7 (probing common "feelings" before smoking episodes), and other responses which implicated smoking behaviour in the regulation of

affective states, were coded independently by two trained raters. Four descriptive content domains were derived for the category of feelings and raw responses were coded according to their fit to the following content areas.

(1) Tense Arousal: Smoking might be associated with regulation of stress-relaxation. Tense arousal descriptors were coded if they referenced a mood state on the bipolar dimension of tense arousal.

(2) Energetic Arousal: Smoking might be associated with regulation of activity-passivity. Energetic arousal descriptors were coded if they referenced a mood state on the bipolar dimension of energetic arousal.

(3) Hedonic Tone: Smoking might be associated with regulation of happiness-sadness. Hedonic tone descriptors were coded if they referenced a mood state on the bipolar dimension of hedonic tone.

(4) Anger/Frustration: Smoking might be associated with regulation of anger. Anger/frustration descriptors were coded if they referenced a mood state on the dimension of anger/frustration.

All affective content domains were based upon the validated factor structure of the UMACL (Matthew *et al.*, 1990), and this allowed the raters to refer to high-loading UMACL items as a guide to apt content within each domain. Usefully, this approach provided an indication of whether smoking-related affects could be reliably subsumed into the UMACL factors, and thus an indication of whether these factors would be aptly applied in repeated diary assessments. It also permitted examination of the perceived relative prominence of these dimensions in (retrospectively recalled) smoking. Inter-rater agreement was substantial (kappa coefficient=0.96) for identifying and categorising feeling descriptors, and disagreements were discussed until agreement on inclusion and classification of content was 100 percent. To control for differences in lexical productivity, mood referencing within each domain was expressed as a percentage of total mood referencing for the purposes of further analyses.

Responses to question 6 (probing specific "thoughts" experienced prior to smoking episodes) were also coded by two independent raters. Raters coded responses into content domains analogous to the two-factor structure of craving cognition – as empirically derived by Tiffany and Drobes (1991).

(1) Positive craving. The content of thoughts associated with smoking might reflect a desire and intention to smoke with smoking anticipated as pleasurable (e.g. Wise, 1988). Positive craving cognition was coded if thought content referenced an urge to smoke or expectancy of positive outcomes of smoking.

(2) Negative craving. The content of thoughts associated with smoking might reflect an anticipation of relief from negative affect and withdrawal (e.g. Shiffman & Jarvik, 1976). Negative craving cognition was coded if thought content referenced a more urgent state of desire or expectancy that smoking would alleviate a negative state.

Inter-rater agreement on categorising cognitive content was good (kappa=0.92) and disagreements were discussed until agreement was 100%. Some of the cognitive content did not fall into either valence domain, and this was reflected in the selective categorisation of the raters. For the purposes of analysis, negative craving was coded as -1, positive craving was coded as 1, and thoughts which did not fall into either category were coded as 0. Cognitive responses were summarised for each individual, so that overall scores reflected a cognitive tendency; participants who gave an equal number of responses in each of the polar categories would thus score 0.

4.3 Results

Smoking Characteristics

Smoking characteristics of the sample are shown in Table 4.1. The average age at which participants started to smoke was 15.2, and this appears to be consistent

with national trends (ONS, 1999). Daily cigarette consumption during participants' heaviest smoking period was, on average, 17.2 cigarettes, but the majority of participants (56.1%) reported smoking less than 10 cigarettes a day at their current rate (or, in the case of former smokers, their regular smoking rate before cessation). This suggests that smokers' consumption rates can fluctuate, and that, even if they do not abstain fully, they are able to reduce their smoking rate from its peak intensity. Current smokers did, however, demonstrate temporal stability in their current smoking behaviours; on average they had been smoking at their current rate for just over four years. Former smokers had been abstinent for little more than two years, on average, and this might reflect the mean age of the sample. Smokers aged 25-44 are most likely to take action to quit in the near future, whereas smokers aged 16-24 are more likely to want to quit without possessing any immediate plans to do so (ONS, 2001); smokers in the present sample tended to be on the borderline of these age groups – and those who had quit smoking are likely to have acted on their desire to do so quite recently, as their desires matured into pertinent behavioural intentions.

Descriptive statistics for FTND score, percentage who smoked in the previous 10 minutes, percentage who smoke in the first hour after waking and percentage who smoke 10 or fewer cigarettes per day suggest that the sample is generally represented by light smokers with little physical dependence on nicotine. For example, Fagerstrom scores less than 4 equate to minimal dependence on nicotine (Heatherton *et al.*, 1991), and the mean score in the present sample is 2. Also, as a national average, 62% of smokers smoke their first cigarette in the first hour after waking (ONS, 2001), compared with 38.1% in the present sample.
Descriptive statistics for the QSU factor scores and cognitive craving content derived from participants' qualitative responses indicate that factor 1/positive craving is more evident in the current sample than factor 2/negative craving. This suggests that, in the present sample, smoking is generally perceived as rewarding,

and that participants are more likely to process an appetitive desire to smoke, rather than an urgent need, in their craving-related cognition. In terms of mood regulation, smoking was associated with all four of the pre-determined, mood-specific categories applied in the coding of participants' qualitative responses. Smoking was most associated with the management of tense arousal and least associated with feelings of anger and frustration.

Table 4.1

Smoking characteristics of the sample

Characteristics	M (n = 139)	SD
Age at first smoke	15.2	2.7
Heaviest daily smoking consumption	17.3	12.0
Months smoking at current rate (current smokers; n = 101)	49.6	74.7
Months abstinent (former smokers; n = 35)	25.7	41.4
FTND score	2.0	2.4
QSU score	2.3	1.4
QSU Factor 1	2.9	1.9
QSU Factor 2	1.7	1.0
Mood regulation		
%TA	67.4	28.4
%HT	22.4	24.7
%EA	11.9	21.2
%AF	3.4	10.8
	Percentage (n = 139)	
% who smoked in the past 10 minutes	26.6	
% who smoke in the first hour after waking	38.1	
% who smoke 10 or fewer cigarettes per day	56.1	
Cognitive craving content		
% positive	41.7	
% neutral	38.8	
% negative	19.4	

FTND = Fagerstrom Test for Nicotine Dependence. QSU = Questionnaire on Smoking Urges

TA=Tense Arousal, HT=Hedonic Tone, EA=Energetic Arousal, AF=Anger/Frustration

External Triggers

Table 4.2 presents the text and frequency counts of the most frequent external triggers participants generated for each pre-determined domain. The obtained triggers are arranged in descending order of their respective frequencies. Frequency cut-off points were set at 5 for both location and activity. There was no cut-off point specified for company because of the minimal range of novel semantic responses.

Table 4.2

Triggers generated within each content domain

Company	Frequency	Location	Frequency	Activity	Frequency
Friend	100	Home	70	Drink alcohol	134
Alone	56	Pubs/bars	56	Rest/relax	116
Partner	21	Outside	37	After meal	97
Family	10	Clubs	26	Pass time/wait	83
Work colleagues	7	Other's house	19	Drink tea/coffee	75
Flatmates	7	Around campus	15	Walking	64
Coursemates	2	Café/Restaurant	7	Watch TV	64
		Car	7	Talking/socialising	53
(Strangers)		Work	7	After sex	50
		Bus/Train stop	5	Study	49
				Telephoning	43
				Drive	35
				Listen to music	17
				Work	10
				Dance	8

Participants endorsed a diverse range of potential trigger activities that they associate with smoking; the cut-off criterion excluded 32 activities – although eighteen of these had a frequency of just one reference. The range of locations produced was distinct, with only six locations (all with frequency scores of one) excluded from the concise situational trigger list. The specified alternatives within the category of company were few, facilitating that the full range of possibilities produced by participants be represented in the concise trigger list. A number of responses in this category were non-specific however (e.g. "whoever's around"), suggesting, deductively, that the addition of a response alternative for "Stranger(s)" in the final trigger list would be necessary to descriptively capture smoking episodes so as to accurately reflect variation in public versus private behaviour. In more than half of responses produced, participants specified whether their usual companions were smokers or non-smokers, indicating that the smoker/non-smoker status of company kept might be an important association to record. The final situational trigger list specifies fifteen activities, ten locations, and eight alternative companion groups.

Responses to question 3, which asked participants to specify *when* they usually smoked, suggested that smokers sampled from the student population tended to smoke more in the evenings; their responses rarely referenced morning smoking – consumption behaviour symptomatic of heavier dependence on smoking and evidently prevalent in the national smoker population. 48.2% of participants specifically referred to evening smoking compared with 5.8% who referred to morning smoking. Responses to question 5, designed to elicit recall of external associations not listed by participants in answers to preceding questions, generally elaborated on triggers captured in other response categories. One frequent, and otherwise uncategorised, trigger - more specific to smokers and tobacco dependence – was identified from analysis of novel responses to question 5. 30.2% of participants referenced sensory cues related to tobacco products and smoking

paraphernalia as being associatively connected to their smoking behaviour; principally they cited the smell of smoke, but they also specified the sight of cigarettes/people smoking and the feel of a lighter or cigarette pack in their hands or pocket as potential triggers.

4.4 Discussion

The design of the smoker diary (and subsequent variants) was partly informed by the findings from the initial study, and there follows a summary of the contributory role of the survey results in the development of the diary. The materials for the smoker diary can be found in Appendix A, and the design and rationale for the smoker diary and subsequent variants are outlined in subsequent sections.

The episodic smoking-diary utilised categorised lists of prevalent contextual correlates of smoking, identified from the qualitative responses to the initial study, to facilitate fast and convenient specification of the situational make-up of each smoking episode (grouped by company, activity, and location). Measures of mood and craving administered in the survey were submitted to factor-analyses to derive the most reliable measures of underlying constructs for the student-smoker population from which subsequent diary-study samples were to be drawn. In the developed episodic smoking-diary, a single-item assessment of craving measured desire to smoke before and after each episode; this item was based on the QSU item which was most highly related to overall QSU in reliability analyses (Item 1; item-total correlation =.96) for the initial study sample. Similarly, the shortened adjective checklist is composed of items that were most reliably related to TA (relaxed, anxious; .67, -.82), EA (active, sluggish; .84, -.79), HT (happy, depressed; .84, -.80) and AF (annoyed; .91). For the purposes of the event-contingent diary, it was reasoned that a valid single-item measurement of desire to smoke would be sufficient: the motivational content of smoking episodes was

tapped by the inclusion of UMACL-derived measures of affectivity, and considerations of assessment-length were prioritised.

The main purpose of fixed-interval assessments in the developed diary-designs was to sample more generalised periodic experiences, in an effort to capture smoking-related processes that might not be evident in episodic data. The developed fixed-interval assessment-sheet partly reflects evidence from responses in the initial study for associations between smoking and the consumption of alcohol and caffeinated drinks (both are among the five most frequently reported smoking-related activities), by recording this consumption across specific time periods. These components of assessment also reflect empirical evidence for associations between smoking and alcohol/caffeine consumption (Miller & Gold, 1998; Lane, 1996). The episodic diary captures co-occurrence of these consumptions with smoking, but their measurement in interval-contingent reports facilitates exploration of slower-acting processes. The Perceived Stress Scale (PSS; Cohen & Williamson, 1988) was embedded as a repeated measure of temporal (rather than event-contingent) fluctuations in negative affectivity, following from findings in the initial study for the particularly strong association between stress/tense arousal and smoking, and theoretical questions about the potentially bidirectional nature of this association (Parrott, 1999). Results suggesting a potential sensory-cueing effect of other people smoking - bolstered by previous findings in the literature (Payne *et al.*, 1991; Perkins *et al.*, 2003) – contributed to the development of interval-contingent measures of passive smoke exposure (frequency, intensity, and duration).

For future studies, it was further decided that the FTND be adapted to yield more variance in measuring physiological dependency – following from Tate and Schmidt (1993). The 10-item Revised Fagerstrom Tolerance Questionnaire (RTQ) scores all items on a 5-point scale, and it was expected that the measure might be more sensitive to degrees of dependence discrepancy between smokers from the student

sub-population – who were found to be clustered around the minimally dependent lower boundary of the overall FTND score. The RTQ has been shown to have greater internal consistency than previously reported for the FTQ and FTND (α = .83).

4.5 Developed diary methods

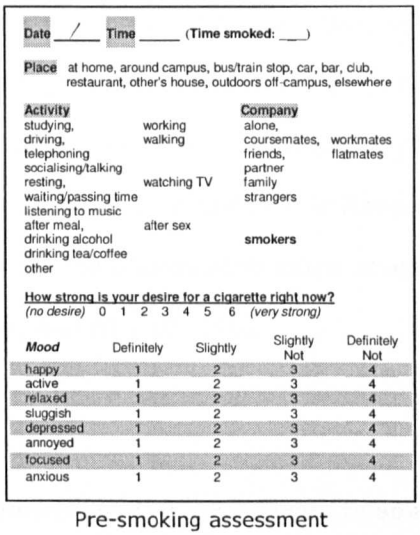
The initial survey study, compounded with related theoretical and empirical literature, led to the development of a smoker diary (see Appendix A) containing both event-contingent and fixed-interval components. Its chief contribution in this regard was in determining the likely situational make-up of smoking episodes in the present population of student-smokers – facilitating the specification of a concise set of response options in event-contingent assessment (as part of efforts to minimise participant burden).

4.5.1 Episodic smoking diary

The developed form of the episodic smoking diary is shown in Figure 4.1. This diary was presented as shown in both the smoking diary and quasi-interventional diary. Adaptations made for the eating diary are detailed in the next sub-section.

Figure 4.1

The episodic smoking diary



Date ___/___ Time _____ (Time smoked: ___)

Place at home, around campus, bus/train stop, car, bar, club, restaurant, other's house, outdoors off-campus, elsewhere

Activity
studying, working
driving, walking
telephoning
socialising/talking
resting, watching TV
waiting/passing time
listening to music
after meal, after sex
drinking alcohol
drinking tea/coffee
other

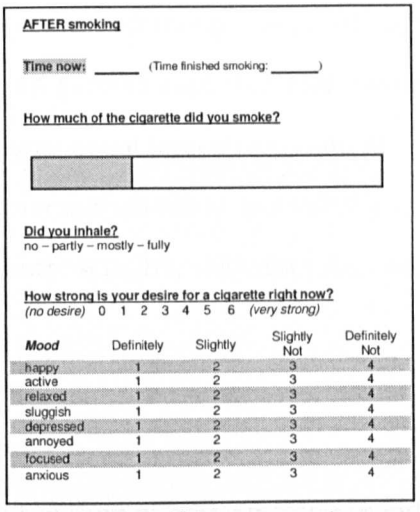
Company
alone,
coursemates, workmates
friends, flatmates
partner
family
strangers

smokers

How strong is your desire for a cigarette right now?
(no desire) 0 1 2 3 4 5 6 *(very strong)*

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

Pre-smoking assessment



AFTER smoking

Time now: _____ (Time finished smoking: _____)

How much of the cigarette did you smoke?

Did you inhale?
no – partly – mostly – fully

How strong is your desire for a cigarette right now?
(no desire) 0 1 2 3 4 5 6 *(very strong)*

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

Post-smoking assessment

Pre-Smoking

Initial items prompted participants to specify the date, time of pre-smoking report, and time actually smoked. Three categorised lists presented options for situational definition. Participants underlined or circled appropriate options in each category: place, activity, and company. Response options were derived from the initial survey study; participants were asked to write down places, activities or companions that did not fit with the presented response options (novel responses represented 3% of the total across categories). A single-scale assessment of current desire to smoke was presented, anchored at 0 = "no desire" and 6 = "very strong" desire. This item was derived from survey results for the QSU. Average reliability (true to total variance of measure, calculated automatically by HLM – see Bryk and Raudenbush, 1992 pp. 39-40) and validity (relationship between original QSU and shortened measure of the same construct, calculated as the square root of the percent of shared variance) was adequate for the abbreviated desire assessment (.82, .69). The final pre-smoking assessment was a short mood-form. Participants rated seven adjectives descriptive of people's moods/feelings according to how indicative each word was of their current mood state; ratings were anchored at 1 = "Definitely"

descriptive of current mood state and 4 = "Definitely Not" descriptive of current mood state. The mood form was derived from high-loading UMACL items (see previous section) such that items tapped the same underlying scales: HT (scored such that high scores equal high happiness), EA (scored such that high scores equal high alertness), TA (scored such that high scores equal high stress) and AF (scored such that high scores equal high irritation). Average reliability and validity was adequate for the abbreviated mood assessments: HT (.85, .78), EA (.56, .66), TA (.84, .34), and AF (.81, .46).

Post-Smoking

Initial items prompted participants to specify the time of post-smoking report and time finished smoking. Two subsequent items were included to gauge episode-specific consumption information. Participants were asked to place a mark on a pictorial visual-analogue scale (VAS) - depicting a cigarette - to indicate how much of the cigarette rod they had consumed. A related four-point scale measured the extent to which participants had inhaled smoke; anchored at 1 = "Not at all" and 4 = "Deeply". Final measures were post-smoking re-tests of desire and mood; these measures were as described for the pre-smoking component of event-contingent assessment.

4.5.2 Event-contingent diary adapted for eating behaviour

This sub-section describes the changes made to the original diary design that facilitated its application to natural consumption events. Where possible, it was intended that the eating diary should have equivalence with the smoking diary.

Pre-Consumption

Initial items prompted participants to specify the date, time of pre-consumption report, and time at which consumption actually commenced. Three categorised lists presented options for situational definition. Response options were minimally adapted from those utilised in the smoking diary (the "after meal" activity option was deleted due to redundancy); participants were asked to write down places, activities or companions that did not fit with the presented response options (novel responses represented 6% of the total across categories). A single-scale assessment of current desire to eat was presented, anchored at 0 = "no desire" and 6 = "very strong" desire. This item was adapted from the QSU-derived measure in the smoking diary, and has the same wording as item 3 of the Hunger Questionnaire administered at baseline. Average reliability and validity (relationship between original HQ and shortened measure of the same construct) was good for the abbreviated desire assessment (.80, .81). The final pre-consumption assessment was a short mood-form, described for the smoking diary. Average reliability and validity was adequate for the abbreviated mood assessments in the present sample: HT (.83, .77), EA (.66, .66), TA (.84, .34), and AF (.81, .46).

Post-Consumption

Initial items prompted participants to specify the time of post-consumption report and time finished eating. Two subsequent items were included to gauge episode-specific consumption information. Participants were asked to list the items they had prepared to eat and record fat/calorific content where known. They were instructed to provide enough information for each episode to be categorised in terms of food-types consumed. A related four-point scale measured the extent to which participants had consumed the food that they had prepared/intended to consume; anchored at 1 = "Very little" and 4 = "All (none left over)". Final measures were post-consumption re-tests of desire and mood; these measures were as described for the pre-consumption component of event-contingent assessment.

4.5.3 Fixed-interval smoking diary

The developed form of the fixed-interval smoking diary is shown in Figure 4.2. This diary was presented as shown in both the smoking diary and quasi-interventional diary. The quasi-interventional study administered one additional assessment: measures of current state (mood and desire to smoke) at each response-interval. This sub-section describes the assessment components of the fixed-interval diary. Adaptations made for the eating diary are detailed in the next sub-section.

Figure 4.2

The fixed-interval smoking diary

Rate how truthfully each statement below reflects your experiences from the time of your previous assessment to the time of the current assessment.

Ratings should be made as a scaled score ranging from 0 to 10 and entered into the appropriate box. A rating of 0 indicates that the statement is completely false (does not reflect your experiences at all), a rating of 10 indicates that the statement is very true of your experiences.

1. "I've felt unable to control the important things in my life"
2. "I've felt confident about my ability to handle personal problems"
3. "I've felt things were going my way"
4. "I've felt difficulties were piling up so high that I could not overcome them"
5. "I've frequently felt an urge or desire to smoke"
6. "The urges, or desires, to smoke that I've experienced have been weak"
7. "The urges to smoke that I've experienced have been lasting a long time"
8. "I've found it difficult to concentrate on what I've been doing"
9. "I have found it easy to ignore potential distractions"
10. "I've frequently been exposed to passive smoke"
11. "Other people's smoke has been very noticeable"
12. "I've not spent any time in smoky environments"

Think back over the experiences you have had since the time of your previous assessment; over this time period:

What was the most pleasurable experience you had?
Rate the pleasantness of this experience out of 10
What was the least pleasurable experience you had?
Rate the unpleasantness of this experience out of 10

Think back over your behaviour since the time of your previous assessment; over this time period:

How many units of alcohol have you consumed?*
How many cups of tea/coffee have you consumed?

Figure 4.2 presents the items assessed in the fixed-interval component of the smoking diary. Responses to these items were obtained at each assessment interval, providing repeated measures time-series data.

Statement Ratings

Participants were instructed to rate the truthfulness of twelve statements as reflecting their experiences over the preceding fixed-period/since the time of their previous assessment interval; ratings were anchored at 0 = "completely false (does not reflect your experiences at all)" and 10 = "very true of your experiences".

Four of the twelve statements (statements 1-4 in Figure 4.2) constituted an embedded form of the Perceived Stress Scale (PSS; Cohen, Karmarck, & Mermelstein, 1983), gauging appraisals of stress experienced between assessment-intervals. Internal consistency of the PSS is good (α = .72), although the 4-item scale is less reliable than the 10-item (α = .85). Test-retest reliability is adequate: .55 over a two-month interval. An overall PSS score was derived from the four items and scored such that high scores equal high stress over the preceding period. Average internal consistency across present studies was adequate (α = .72)

Urges to smoke experienced over the preceding fixed-period were gauged at each assessment-interval by three items (statements 5-7): separate statements described frequency, intensity, and duration of periodic craving. Statement ratings were scored such that high scores equal high frequency, intensity, and duration as appropriate (to this end, the intensity item was reverse-scored). Recording of craving experiences across three dimensions follows the recommendations of Halikas (1997) and may help to aid period-recall by providing a demarcated structure for retrieval (Eysenck, 1979). Two related statements measured distractibility over the preceding period (statements 8 and 9); smoking may improve concentration (Zhang & Sulzer, 2004), and a regulatory relationship could develop such that impaired concentration motivates smoking behaviour (Heishman, 2001). Statement ratings were scored such that high scores equal high difficulty concentrating, and a total distractibility score was derived from the two pre-scored items.

Passive-smoke exposure over the preceding fixed-period was gauged at each assessment-interval by three items (statements 10-12): separate statements described frequency, intensity, and duration of exposure to others' smoking. Statement ratings were scored such that high scores equal high frequency, intensity, and duration as appropriate (to this end, the duration item was reverse-

scored). Assessment of exposure to others' smoking was incorporated on the basis of evidence for cueing of smoking/craving by smoking-related stimuli (Drobes & Tiffany, 1997; Niaura *et al.*, 1992; Payne *et al.*, 1991) – such as the sight or smell of people smoking.

Salient experiences

Participants were asked to provide a brief description of their most pleasurable experience over the preceding fixed-period/since the time of their previous assessment interval, and to accord a rating of pleasantness to this experience; ratings ranged from 0 to 10, where 10 is equal to a very pleasant experience. Participants were further asked to provide a brief description of their least pleasurable experience over the preceding period, and to accord a rating of unpleasantness to this experience; ratings ranged from 0 to 10, where 10 is equal to a very unpleasant experience. Experience descriptions were elicited to aid recall (encouraging focus on a specific elaborated event; Schacter, 2001), thus facilitating more accurate ratings of salient valenced events. Experience descriptions were not coded for the purpose of further analyses

Consumption

Participants were instructed to record consumption of alcohol and caffeinated drinks over the preceding fixed-period/since the time of their previous assessment interval. Alcohol consumption was recorded in units (where 1 unit = 10ml Ethanol), and participants were provided/trained with a unit-calculation table to assist in this process. The number of caffeinated drinks consumed was recorded. Smoking behaviour is associated with consumption of alcohol and caffeine (Istvan & Matarazzo, 1984; Miller & Gold, 1998; Lane, 1996) and this relationship may not be limited to an episodic/smoking-concurrent association. More complex periodic relationships might arise as consumption of one substance (nicotine/caffeine/alcohol) could temporarily sate desire for another, and/or

periodic abstinence from one substance might later culminate in greater consumption of another (Henningfield, Clayton & Pollin, 1990; Willner, Hardman & Eaton, 1995; Taylor *et al.*, 2000).

Current mood and craving (quasi-intervention only)

The utilised state measures of current state in the quasi-intervention diary were the UMACL-derived mood-form and QSU-derived desire scale that were administered in event-contingent assessments (pre- and post-event) across all samples. These measures facilitated analysis of state-changes over the abstinence period that, in cases where the participant managed to abstain fully (zero smoking events), would not be captured by event-contingent assessments. Assessment of mood and desire at numerous intervals was further considered to potentially present a more reliable means of deriving baseline (i.e. not smoking-contingent) states than from a single-time assessment.

4.5.4 Fixed-interval diary adapted for eating behaviour

This sub-section describes changes made to the fixed-interval diary design that facilitated its application to natural consumption events. Where possible, it was intended that the eating diary should have equivalence with the original smoking diary.

Statement Ratings

As in the original design, four of the twelve statements constituted an embedded form of the PSS. Internal consistency of the PSS was adequate in the present sample ($\alpha = .74$).

Urges to eat experienced over the preceding fixed-period were gauged at each assessment-interval by three items: separate statements described frequency,

intensity, and duration of periodic hunger. Two related statements measured distractibility over the preceding period. Items were designed to be equivalent to items pertaining to urges to smoke in the fixed-interval smoking diary, and were scored accordingly.

Exposure to other people eating (over the preceding fixed-period) was gauged at each assessment-interval by three items: separate statements described frequency, intensity, and duration of exposure to others' consumption of food. Again, items were designed to be equivalent to items pertaining to passive-smoke exposure in the fixed-interval smoking diary, and were scored accordingly.

Components assessing *Salient experiences* and *Consumption* (of alcohol and tea/coffee) were unchanged from the smoking diary. Note that the eating study did not include measures of current state that were added to the quasi-interventional version of the smoking diary.

4.6 Diary procedures

This section presents the procedures for each of the three diary studies that were developed: the smoking diary, eating diary, and quasi-interventional diary.

4.6.1 Smoking diary

Participants consenting to take part in the study (by completing the Participant Consent Form) provided responses to a one-off initial assessment (administered at the point of intake) and agreed with the researcher a start date for commencing their 48-hour monitoring period. At intake, participants received personal instruction in how to perform this monitoring, and had the opportunity to discuss

the procedure with the researcher and clarify their understanding of the printed materials.

The initial (intake) assessment comprised a series of questionnaire items designed to explicate participants' history of smoking behaviour, smoker typology, and readiness to change. The initial assessment also included a number of validated tests intended to gauge motivational sensitivity/personality (BIS-BAS scales; IPIP Big 5), nicotine dependence (Revised Fagerström Tolerance Questionnaire), and baseline levels of mood (UWIST Adjective Checklist) and craving (QSU). Participants were asked to complete mood and craving measures twice: once before lunch and once in the evening. They were instructed to complete the mood and craving assessments at points between smoking episodes, and not immediately before or after. The initial assessment took no longer than 25 minutes to complete in piloting (n = 15) and was completed in the participant's everyday context prior to participation.

At 8pm on the agreed start date, participants completed the first of five fixed-interval assessments, and began to monitor smoking episodes as and when they occurred.

The fixed interval assessments required that participants recall and record their experiences and behaviours since the time of their previous fixed assessment. Each fixed assessment had three components. The first component measured the extent of participants' perceived experiences of stress (an embedded modification of the Perceived Stress Scale), exposure to sensory triggers (frequency, duration and intensity of passive smoke exposure), distractibility, and (frequency, duration, and intensity of) craving. Participants were instructed to score a series of statements (designed to tap the occurrence of these phenomena) according to how truthfully they reflected their personal experiences. The second component instructed

participants to think of the most pleasurable and least pleasurable events that had occurred since the previous fixed assessment, and accord a rating of pleasantness/unpleasantness to each as appropriate. The final component instructed participants to state their caffeine and alcohol consumption (a table was provided to assist with the calculation of unit alcohol consumption), and to indicate the amount of money that they had spent on tobacco products. Each fixed-interval assessment took no longer than five minutes to complete in piloting.

The event-contingent assessments required participants to record their state immediately prior to, and immediately after, each smoking episode. For each cigarette they smoked, participants used a separate Cigarette-diary sheet to specify the context (location, activity, company) in which they were about to smoke - selecting from a number of listed options. They also reported the strength of their urge to smoke (on a 7-point Likert scale), and their pre-smoking mood (a piloted derivation of the UWIST Adjective Checklist). After smoking, participants used the second side of the cigarette-diary sheet to indicate how much of the cigarette they smoked - on a pictorial VAS of a cigarette rod. They also indicated to what extent they inhaled the smoke, and performed post-smoking re-tests of their urge to smoke and mood-state. The Cigarette-diary sheets were compact enough to be kept with/in a cigarette packet, and completion of each episodic assessment (pre and post) took no longer than two minutes in piloting.

Forty eight hours after the agreed start time, participants completed their fifth and final fixed-interval assessment and ceased event-contingent monitoring of their smoking episodes. After handing the completed materials back to the researcher, participants were verbally debriefed and given the opportunity to ask any further questions they had about the purpose or design of the study. They were also afforded the opportunity to withdraw their responses from further analyses if they so wished.

On completion/withdrawal of participation, participants received a Quit-line sheet providing contact numbers for organisations offering advice on smoking cessation.

4.6.2 Eating diary

The procedure for the eating diary replicated that of the smoking diary. It differed only in some aspects of content assessment (detailed in the preceding section and Chapter 3).

4.6.3 Quasi-intervention diary

The procedure for the quasi-interventional diary differed in some resects to that of the smoking diary; differences in protocol are described in this sub-section.

Participants consenting to take part in the study (by completing the Participant Consent Form) provided responses to a one-off initial assessment (administered at the point of intake) and agreed with the researcher a start date for commencing their 72-hour monitoring period. At intake, participants received personal instruction in how to perform the monitoring, and had opportunity to discuss the procedure with the researcher and clarify their understanding of the printed materials.

The initial (intake) assessment was the same as that administered to participants in the original Smoker Diary.

At 8pm on the agreed start date, participants completed the first of seven fixed-interval assessments, and began to monitor smoking episodes as and when they occurred.

The fixed interval assessments were composed of components administered in the original Smoker Diary, plus an additional component: participants were instructed to complete a short assessment of their affective state and desire to smoke as experienced at the time that they were giving their responses. The extended fixed-interval assessment took no longer than seven minutes to complete in piloting (n = 5).

The event-contingent assessments were the same as those administered in the original Smoker Diary.

Twenty four hours after the agreed start time, participants entered a period of encouraged abstinence. For the duration of this 24-hour period, participants continued to complete fixed assessments and monitor smoking events (lapses) if and when they occurred, but they were aware that they have been asked to attempt abstinence from smoking for this phase of their participation.

Seventy two hours after the agreed start time, participants completed their seventh and final fixed-interval assessment and cease event-contingent monitoring of their smoking episodes. After handing the completed materials back to the researcher, participants had a further opportunity to ask questions about the purpose and design of the study. They were also given the opportunity to withdraw their responses from further analyses.

4.7 Diary compliance

4.7.1 Event-contingent

Participants were instructed to specify the time that they actually smoked/ate separately from the time at which they completed the pre- and post-event assessments. Participants were informed that responses for episodes that had not

been assessed promptly would be acceptable for further analysis, providing that all times were recorded accurately. They were further informed that the influence of response latencies could be meaningfully modelled, and that honesty about compliance was more important than compliance per se. The provision of such information was intended to give the impression that the study demanded precise reporting over prompt reporting – so as to maximise compliance.

In practice, noncompliant episodes were not utilised in analyses pertaining to the central hypotheses of the study. Episodes were classed as noncompliant if there was a discrepancy between the times at which participants reported initiating and terminating smoking and the reported times at which they completed pre- and post-smoking assessments respectively; across all studies, 286 episodes were classed as noncompliant, representing 15.9% of the total reported. Analyses of episodes categorised as noncompliant indicated that there were no differences between pre- and post-event mood scores, suggesting that attempts to reconstruct mood in retrospective recall of episodes produced data that did not show any systematic trends (in contrast to findings relating to data reported as being fully compliant). The finding that data from noncompliant episodes showed random variation that was not evident in episodes categorised as compliant suggests that participant-reported compliancy may be accurate - reflecting a real difference between contiguous and delayed responding.

Further support for the accuracy of compliance reporting may be inferred from the general tendency in the studies of smoking for smoking episodes to be reported at a lower frequency than would be expected from participants' initial estimates of their typical smoking rates. Inconvenience of monitoring may alter behaviour, and this has not been disguised in the present studies, suggesting that participants did not perceive a demand to fabricate responding. This suggestion was bolstered by feedback in debriefing. Reports implied that participants found the monitoring to be

inopportune in certain situations, but that they did not feel that they had to conceal this in their responding. If they were late to respond, they reported relevant times accurately as instructed. Feedback in the eating study suggested that this monitoring was more convenient: eating episodes were generally less frequent and tended to occur in situations suited to making diary entries (e.g., when sat at a dining table).

Although instructions were designed to minimise compliancy demands, and there is evidence to suggest that participants were accurate in reporting compliance, the nature of the present self-report protocol is such that the actual compliance rate may have differed from the indicated rate - a problem inherent in paper-based diaries (Stone *et al.*, 2002; 2003). However, due to the event-contingent nature of the monitoring, it is unlikely that the use of standard electronic diaries would have afforded more accurate compliance information. Assessments of this kind have to be initiated by the participant, and could not be signalled externally without innovative implementation of sophisticated sensor technology. The present approach to implementing event-contingent assessments of mood is not without precedence in the literature (e.g., Peeters *et al.*, 2003).

4.7.2 Fixed-interval

The signalling/time-stamping properties of electronic diary instruments would have been useful in encouraging and assessing compliance in the fixed-interval component of applied diary-designs. Internal clocks can be tampered with and scheduled signalling may be disruptive or inconvenient in certain contexts (Scollon *et al.*, 2003), but, in view of the findings of Stone and colleagues (2002, 2003), electronic diary instruments would have been preferred (for interval-contingent measurement) if the requisite resources were available. However, the present research followed all recommendations for maximising compliance in paper-based

diary protocols (Bolger *et al.*, 2003; Scollon *et al.*, 2003): diary sheets folded down to pocket-size and were easily portable, dates and times were pre-printed onto diary sheets to reduce participant error, allowances were made for participants to specify the time at which assessments were actually completed (in a way that recognised that they wouldn't always be on time), ongoing contact was maintained and responses were checked daily (when completed event-contingent sheets were collected), diary forms were pilot-tested within the intended population of study, participants were given thorough training on the procedures (practicing completion of each component), and appropriate monetary incentives were offered.

4.8 Next chapter

Chapter 5 is the first of the results-based chapters examining key issues of the research. As such, this chapter considers the primary issue of the research: testing potential models of mood-smoking reinforcement as they apply in everyday smoking episodes. Chapter 5 further extends its focus on mood-smoking relationships to examine covariance with contemporary context and craving.

Chapter 5. Models of mood and episodic correlates

The present chapter tested potential models of smoking-related mood change and how these interact with contextual cues present at the time of smoking.

The primary prediction was that that mood would change in relation to episodic smoking. The emergence of a systematic pattern of change would allow a test of the three theoretical models, as they are evinced over time in everyday smoking behaviour. It was difficult to predict which model would prove the best fit to data as the literature has been inconsistent in its support of one model over the others (Zinser *et al.*, 1999) - and studies have not examined models as they apply to naturalistic data (Kalman, 2002).

On balance, previous laboratory research has indicated that smoking ameliorates negative mood (Gilbert & Wesler, 1989; Payne *et al.*, 1991; Brandon., 1994). This is consistent with predictions of the associative-withdrawal model. Many influential researchers continue to support negative affective reinforcement (associative-withdrawal) as the primary motivation for episodic smoking (Baker *et al.*, 2004b; Koob, 2003; Eissenberg, 2004).

However, some recent studies suggest that – in conditions that more closely resemble normal smoking (no enforced deprivation prior to testing; perceived access to cigarettes) – smoking may be motivated by mood-enhancing expectations (Mucha *et al.*, 1999; Huston-Lyons & Kometsky, 1992; Shapiro *et al.*, 2002). As the present study examined smoking in its natural environment, this research was considered more indicative of likely outcomes: suggesting hypothesis in favour of incentive-based models (appetitive-incentive and incentive-sensitisation theories). In their meta-analysis of physiological responses (heart-rate and skin conductance) to drug cues, Carter and Tiffany (1999) concluded that incentive models

(appetitive-incentive and incentive-sensitisation theories) are better supported overall (consistent with earlier reviews by Niaura *et al.*, 1998; and Rohsenow *et al.*, 1990-91). Although testing conditions and measures used in reviewed studies differ from the present methodology, and summarise evidence from multiple substances of dependence, these findings further influence predictions against the associative-withdrawal model. It is notable that recent studies have specifically supported an incentive-sensitisation (rather than appetitive-incentive) model of smoking motivation, with convergence of several methodological approaches: looking at neurotransmission, functional imaging, and learning paradigms in humans and animals (Balfour, 2003; Zinser *et al.*, 1999; Donny *et al.*, 2003).

Given the conceptualisation of smoking as a rewarding behaviour, it was further predicted that BAS-related mood dimensions would be central to reinforcement motivation. Chiefly, hedonic tone and/or energetic arousal were expected to emerge as key indices (Carver & Scheier, 1998). Note however that tense arousal emerged as the most prominent smoking-associated mood in the general recall of participants in the initial study (chapter 4). Retrospective reports often claim that regulation of tense arousal is an important function of smoking, but such reports have proved difficult to substantiate (Kassel *et al.*, 2003). A basic validatory expectation was that desire to smoke (craving) would demonstrate an inverted-U trend in relation to smoking. It was hypothesised that craving would show relationship with mood changes, although the likely heterogeneity of craving permitted little more than speculative reasoning in this regard. Available indications are that craving is especially tied to negative mood (Tiffany, 1992); but this relationship is most clearly seen when smoking is restricted (Sayette & Huffard, 1995; Tiffany, 1995), and may not be evinced in normal smoking.
Following indications from clinical reports and conditioning research, it was expected that mood and craving would exhibit state dependencies/contextual sensitivity (Shapiro *et al.*, 2002; Mackintosh, 1983; Baker *et al.*, 2004a). Many

studies indicate that the subjective effects of smoking (and other drugs) depend on situation (Gilbert, 1997). For example, in the laboratory, mood effects have been shown to interact with concurrent activity (Kassel & Shiffman, 1997).

This chapter had the following aims:

1. To test three potential models of mood-smoking, by identifying which model best describes mood change across two stages of smoking: (1) from baseline to pre-smoking, and (2) from pre- to post-smoking.
2. To assess potential covariation of mood-smoking relationships at each of the two stages with contextual variability.
3. To characterise craving change across stages and its relationship with mood and contextual variability.

5.1 Investigative approach

Data analysis proceeded in three stages, reflecting the main aims of the chapter. Firstly the three competing models were compared. This is followed by modelling of episodic covariation between identified mood changes and contextual variables. Finally, desire scores were examined for significant variability and submitted to modelling as a function of contextual and mood variables. Analyses in this chapter examined combined data-sets from the smoking diary and quasi-interventional diary (only episodes from the initial free-smoking period were used in this analysis). These data sets were combined as they both contained information relevant to the questions explored in this chapter, and were equivalent in terms of procedure and variables assessed. The merging of these data-sets yields more power for examining the central questions of this thesis: those concerning smoking in relation to mood (this chapter) and personality (chapter 6).

5.1.1 Comparing the three models

Initially, model-fit for each dimension of mood was examined using a series of hierarchical multivariate models: with mood in each of the three sampled conditions (baseline, pre-smoking, and post-smoking; level one) nested within persons (level two). For the purposes of this analysis, dummy variables were constructed to represent the three models under test. Variables were assigned three parameter values, reflecting predicted mood patterns across conditions. The following variables (with associated functions and dummy values) were produced in this manner: Appetitive Incentive (linear-increase function; 0, 1, 2), Associative Withdrawal (U-shaped function; 1, 0, 1), and Incentive Sensitisation (step-increase function; 0, 1, 1). A negative trend for positive mood and Associative Withdrawal would also support the incentive-sensitisation conceptualisation, specifically an incentive-sensitisation model wherein positive mood decreases post-consumption (inverted-U function; 0, 1, 0).

Relationships between mood and model representations were examined with the following within-person (level 1) model separately for each of the dimensions of mood:

$$y_{ij} = \beta_{0j} + \beta_{1j}\,(AI/AW/IS) + r_{ij}.$$

In this model, y_{ij} is a measure of average mood (HT, EA, TA, or AF) for person j in condition i (baseline, pre-smoking, post-smoking), β_{0j} is a random coefficient representing the intercept of y for person j (mean mood across conditions), β_{1j} is a slope representing the within-person relationship between model (AI, AW, or IS) and mood for person j, and r_{ij} represents error.

To determine if model representations covaried with mood (i.e., whether model slopes were significantly different from 0 across the individuals in the study), the following person-level model was examined:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

The significance of γ_{10} indicated if, on average, the relationship between mood and model was different from zero. Such models are referred to as models of "slopes as outcomes" because slopes from a level 1 model are considered as outcomes (dependent variables) at level 2.

Responses pertaining to each of the dimensions of UMACL mood were subsequently submitted to a repeated measures Multivariate Analysis of Variance (MANOVA) - to identify significant differences between baseline, mean pre- and mean post-smoking responses. Baseline scores constituted (the average of) summed item scores for representative UMACL adjectives used in the event contingent component of the study, such that scores at the three intervals were all derived from the same adjective-rating items. The MANOVA was conducted to examine general mood change across states and identify the primary affective/arousal components associated with smoking events. Only mood dimensions demonstrating a significant main effect of change (across the three testing intervals) in the MANOVA were submitted to further analyses. These further analyses again took the form of multilevel modelling.

5.1.2 Mood changes and episodic context

The within-person (level 1) changes in mood - from baseline to pre-smoking and pre- to post-smoking - represent theoretically distinct processes (Rohsenow *et al.*,

1990-91, Benowitz, 1992) and can be analysed separately and combined to imply overall model-fit for the sample. It is then possible to analyse covariation between mood change scores and context at each stage.

For each recorded smoking episode, average baseline scores (derived from the UMACL items that corresponded to items incorporated in the episodic cigarette diary) were deducted from pre-smoking item scores, and pre-smoking mood scores were deducted from corresponding post-smoking mood scores. The initial models in these analyses were unconditional. The basic level 1 (episodic or within-person) model was:

$$y_{ij} = \beta_{0j} + r_{ij}.$$

In this model, y_{ij} is an episodic measure of mood for person j at episode i, β_{0j} is a random coefficient representing the mean of y for person j (across the i episodes for which each person provided data), r_{ij} represents the error associated with each measure, and the variance of r_{ij} constitutes the episode level residual/error variance. To determine whether mood change scores were significantly different from 0 across the individuals in the study, the basic level 2 model was examined:

$$\beta_{0j} = \gamma_{00} + u_{0j}.$$

In this model, γ_{00} represents the grand mean of the person level means (β_{0j}s) from the episode level model, u_{0j} represents the error of β_{0j}, and the variance of u0j constitutes the level 2 residual/error variance.

The secondary aim of this chapter was to identify covariation between mood changes and contextual variables. Such relationships were examined using the following episode level model separately for each mood change score:

$$y_{ij} = \beta_{0j} + \beta_{1j} \text{ (CONTEXTUAL VARIABLE)} + r_{ij}.$$

This model is similar to the model used to examine relationships between mood and model representations. The slopes now reflect within-person relationships between mood changes and episodic context. For the purposes of modelling, continuous variables were group-mean centred to eliminate the influences on parameter estimates of individual differences in a given contextual variable. Dichotomous variables were entered without centring. Thus, coefficients for each individual described relationship between deviations from their mean score on a contextual variable and deviations from their mean mood-change score.

Variables relating to context were examined across five categories: temporal, company, location, activity, and consumption. Location and activity variables were constructed by a process of category-generation and assignment applied to the original response options in the event-contingent diary. Two independent coders performed this procedure. Temporal variables were *episode length* (in minutes), *minutes since smoked* and *serial position* (nth episode of the day). Company variables were *others not smoking* (coded as 0 = alone at time of episode, 1 = with others, who were not smoking) and *others smoking* (0 = no-one else smoking at time of episode, 1 = others smoking). Location variables were *home*, *social venue*, and *outdoors*; all three were binary variables (coded as 0 = episode occurred elsewhere, 1 = episode occurred in this place-type). Activity indicator variables were *resting*, *working*, *active-engagement*, *drinking alcohol*, *drinking tea/coffee*, *post-eating*, and *post-sex*; all were binary variables reflecting non-

occurrence/occurrence in this state of activity. Consumption variables were *cigarette rod remaining* (in mm scaled), and *extent inhaled* (4-point scale).

To determine the contextual covariates that had a unique relationship with mood change, significant predictors in the above model – where one contextual variable is analysed at a time – were analysed further. Firstly, predictive contextual variables were examined as a function of each other to identify covariation between predictors. Finally, covarying predictors were entered together into a model with mood change again as the dependent variable. Contextual variables that showed significant covariation with mood change in this final stage of analysis were reported as variables demonstrating direct (extra-mediated) relationships with mood change.

5.1.3 Craving and its relation to mood and context

Final analyses in this chapter pertained to desire to smoke and its covariation with mood and context. The programme of analyses applied was similar to that followed for investigation of mood changes.

Initially, desire ratings were submitted to a repeated measures Multivariate Analysis of Variance (MANOVA) - to identify significant differences between baseline, mean pre- and mean post-smoking responses. Baseline desire score was obtained from the QSU item used in the event contingent component of the study (Item 1: "How strong is your desire to smoke right now?"), such that scores at the three intervals were all derived from the same measure. Subsequent analyses examined significant change scores using multilevel modelling techniques. For each recorded smoking episode, baseline desire scores (averaged) were deducted from pre-smoking scores, and pre-smoking scores were deducted from corresponding post-smoking scores. Unconditional models were examined to replicate MANOVA findings with the

non-aggregated nested data-set, and level-1 slope models were constructed (in the manner previously described) to identify covariation with other episodic measures. The same sets of contextual variables that had been modelled in relation to mood changes were examined in relation to desire changes; but the first models at this stage of analysis tested covariation between changes in mood and changes in desire.

5.2 Results

5.2.1 Comparing the three models: Relationships with Mood

To address the first main aim of the chapter - to compare three potential models of mood and smoking - a series of models were constructed to fit mean mood to estimated change functions representing the theories under test (Appetitive Incentive, Associative Withdrawal, and Incentive Sensitisation).

HT was positively related for function variables representing the Appetitive Incentive (γ_{10} = .02, t = 4.23, p < .001) and Incentive Sensitisation (γ_{10} = .04, t = 4.63, p < .001) models. Goodness of fit was slightly better for Appetitive Incentive (deviance = -450.5, estimated parameters = 4) than Incentive Sensitisation (-453.65, 4). EA was positively related for Appetitive Incentive (γ_{10} = .03, t = 3.66, p < .001) and Incentive Sensitisation (γ_{10} = .07, t = 4.66, p < .001), and negatively related for Associative Withdrawal (γ_{10} = -.04, t = -2.67, p = .008). Goodness of fit was slightly better for Associative Withdrawal (-307.51, 4) than Appetitive Incentive (-313.35, 4) and Incentive Sensitisation (-320.70, 4). The significant negative covariation between EA and Associative Withdrawal supports an incentive-sensitisation model wherein alertness decreases following consumption. TA was negatively related for Associative Withdrawal (γ_{10} = -.03, t = -2.13, p = .03). Because TA is scored such that high scores indicate high stress, this relationship

supports an associative-withdrawal pattern of tension regulation. AF was not related to any of the coded variables.

Analyses in this section suggest that both EA and HT are represented by models predicting elevation of positive mood from baseline to pre-smoking state. The compatibility of these mood dimensions with multiple models (both appetitive-incentive and incentive-sensitisation interpretations) suggests that changes from pre- to post-smoking may be less consistent. In contrast, TA was uniquely fitted to an associative-withdrawal function.

5.2.2 Comparing the three models: Changes in mean mood

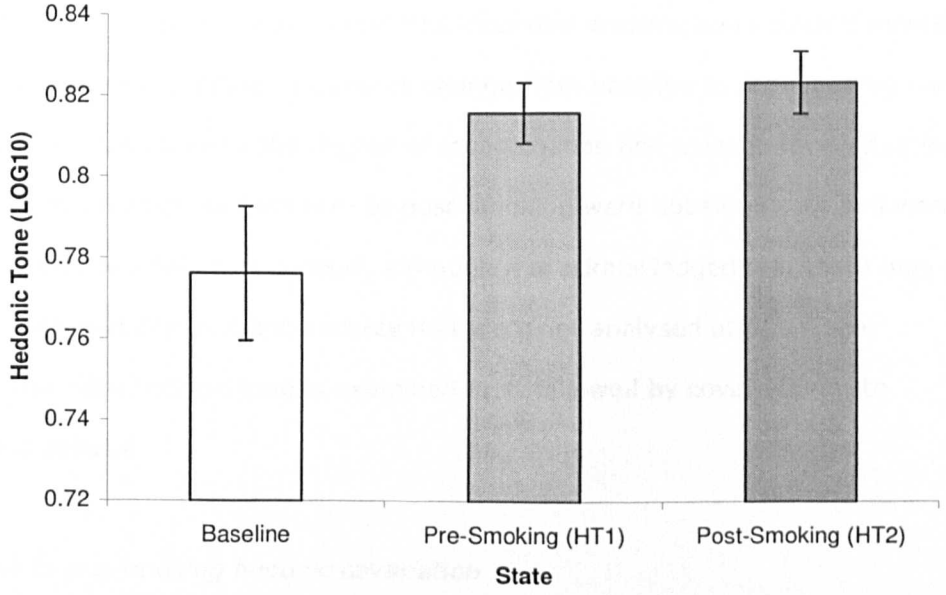
A repeated measures MANOVA was performed on mean scores for the four dimensions of mood across the three testing intervals: baseline, episodic pre-smoking, and episodic post-smoking. The MANOVA served to identify the most changeable (motivationally salient) dimensions of mood, and better specify the direction of any effects for each component of change (baseline to pre-smoking and pre- to post-smoking). For all dimensions of mood, responses were log transformed to normalise error distribution prior to the MANOVA. Untransformed data was used to derive the episodic change scores applied in subsequent HLM analyses (these change scores had uniform residuals).

The MANOVA revealed significant main effects of hedonic tone [$F(2,138)= 11.46$, $p = .001$] and energetic arousal [$F(2,138)= 11.97$, $p = .001$], no main effects of other mood dimensions were observed. Figure 5.1 indicates that hedonic tone and energetic arousal demonstrate a similar pattern of change. Simple main effects analyses were carried out on the mean differences in hedonic tone and energetic arousal. Pre-smoking hedonic tone (HT-pre) was significantly greater than hedonic tone at baseline (HT base) [$F(1,69)= 9.98$, $p < .005$]; post-smoking hedonic tone

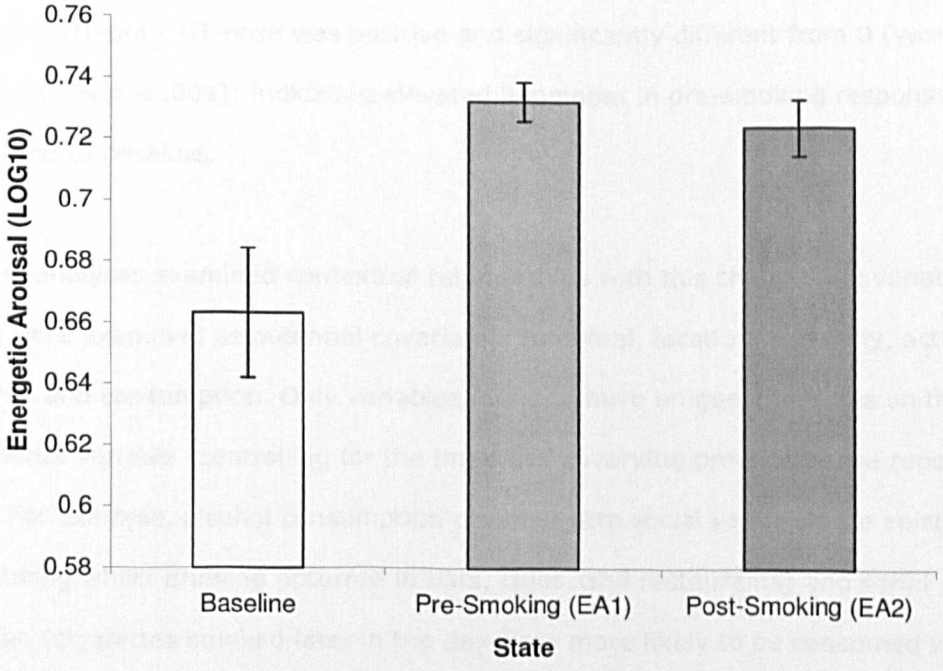
(HT-post) was not significantly different from HT-pre. Pre-smoking energetic arousal (EA-pre) was significantly greater than energetic arousal at baseline (EA-base) [$F(1,69)= 14.06$, $p < .001$]; post-smoking energetic arousal (EA-post) was not significantly different from EA-pre. These findings support an incentive-sensitisation account of motivation. MANOVA results are thus consistent with preceding model-fit analyses in the implication that, for hedonic and energetic dimensions, only positive mood changes from baseline to pre-smoking are consistent. Following from the MANOVA results, further analyses were limited to the examination of hedonic tone and energetic arousal responses, and specifically to scores reflecting changes from baseline to pre-smoking state.

Figure 5.1

Mean hedonic tone at baseline, pre-smoking, and post-smoking states



Mean energetic arousal at baseline, pre-smoking, and post-smoking states



Note. Error bars depict standard deviations

5.2.3 Mood changes and context: Episode-level models

The second main aim of this chapter was to explore if context variables covary with the best fitting mood-smoking model (the incentive-sensitisation account) identified above. The present analyses examined change from baseline to pre-smoking mood and relationships between the degree of mood change and episode-level situational variation. Mood changes from pre- to post-smoking were not significant and were not examined in relation to context, although it is acknowledged that there may be significant variability in change scores that were not analysed at this stage. Covariation with hedonic tone is examined first, followed by covariation with energetic arousal.

Baseline to pre-smoking hedonic covariation

The first model of hedonic tone change from baseline was an unconditional model, with the difference score (pre-smoking hedonic tone minus baseline hedonic tone; HT-pre - HT-base) entered at level 1. As suggested by previous aggregate-based analyses, HT-pre - HT-base was positive and significantly different from 0 (γ_{00}= .50, t= 3.73, $p < .001$): indicating elevated happiness in pre-smoking responses as compared to baseline.

Further analyses examined contextual relationships with this change. Six variable-types were examined as potential covariates: temporal, location, company, activity, craving, and consumption. Only variables found to have unique influences on the dependent variable (controlling for the impact of covarying predictors) are reported here. For example, alcohol consumption covaried with social venue (more episodes of smoking whilst drinking occurred in bars, clubs, and restaurants) and serial position (cigarettes smoked later in the day were more likely to be consumed with alcohol), and all three of these variables were found to be related to HT-pre - HT-base. Given this covariation, further models were constructed wherein HT-pre - HT-

base was examined as a joint function of alcohol, social venue, and serial position. The context coefficients in this analysis remained significant ($ps < .005$) suggesting that all three variables had a unique influence. Similar models were constructed for all combinations of covarying predictors of HT-pre - HT-base; slopes for unique predictors are reported here as derived from single-function models. The results of these analyses are summarised in Table 5.1 below.

Table 5.1

Episodic relationships between significant mood changes and contextual variables

	γ_{00}	γ_{10}	*t*	*p*
HT-pre – HT-base	.50		3.73	<.001
Serial position		.06	3.48	.001
Others smoking		.41	2.89	<.001
Others not smoking		.30	3.65	<.001
Post-sex		1.24	7.14	<.001
Post-eating		.22	2.14	.032
Drinking alcohol		.65	4.89	<.001
Working		-.53	-3.50	.001
Social venue		.70	5.26	<.001
EA-pre – EA-base	.68		4.10	<.001
Resting		-.49	-4.39	<.001
At home		-.71	-6.60	<.001

HT1-base = Change in hedonic tone from baseline to post-smoking state. *EA1-base* = Change in energetic arousal from baseline to pre-smoking state.

Note. Mean unstandardised coefficients are in the columns labelled γ00 and γ10

In terms of temporal variability, elevation of hedonic tone (from baseline) tended to increase with each cigarette smoked in a daily cycle (from waking to sleeping). The mean slope between HT-pre – HT-base and serial position was positive and significantly different from 0 (γ_{10}= .06, *t*= 3.48, *p* = .001; shown in row 3 of Table 5.1; henceforth, the reader is referred to Table 5.1 to obtain statistics for slopes detailed in this section). In terms of location, elevation of happiness was greater in episodes where smoking occurred in social venues. Elevation of happiness was

greater in episodes where the smoker was accompanied; either by other smokers or by non-smokers. Elevation of happiness was greater when smoking after sex, after food consumption, and whilst drinking alcohol. Elevation was attenuated during work/study activity. Craving and consumption variables did not covary with HT-pre –HT-base.

Baseline to pre-smoking energetic covariation

The unconditional model was significant: indicating elevated alertness in pre-smoking responses as compared with baseline. Further analyses examined contextual covariation with this change (EA-pre - EA-base). Elevation of alertness was reduced when smoking episodes occurred whilst at home and when resting. No other contextual variables were uniquely predictive of EA-pre – EA-base, although HT-pre – HT-base appeared to mediate the effects of some contextual variables (alcohol, social venue); elevation of alertness tended to be greater when elevation of happiness was greater (γ_{10}= .67, t= 4.08, $p < .001$).

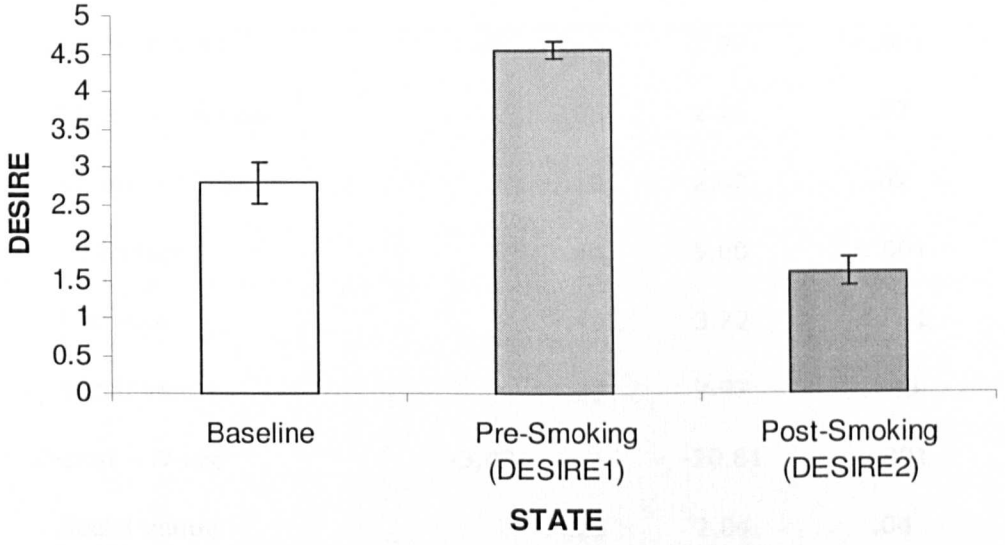
5.2.4 Craving and its relation to mood and context

The third main aim of this chapter was to characterise acute episodic changes in desire to smoke and their relationship with mood changes and contextual variability at the same level.

A repeated-measure MANOVA was performed on mean desire score across the three testing intervals: baseline, episodic pre-smoking, and episodic post-smoking (see Figure 5.2). A significant main effect was found [$F(2,138)$= 15.46, $p < .001$]. Simple main effects analysis indicated that pre-smoking desire (D-pre) was significantly greater than desire at baseline (D-base) [$F(1,69)$= 7.83, $p < .001$] and post-smoking desire (D-post) was significantly less than D-pre [$F(1,69)$= 20.34, $p < .001$].

Figure 5.2

Mean desire at baseline, pre-smoking, and post-smoking states



Note. Error bars depict standard deviations

Subsequent multilevel analyses modelled desire-change scores unconditionally and as a function of other level-1 variables. Desire change from baseline to pre-smoking is examined first, followed by change from pre- to post-smoking. Table 5.2 shows significant desire-change coefficients (γ_{00}) and relevant covariation with episodic context (γ_{01}). These values are not restated in the main body of this section of results.

Table 5.2

Episodic relationships between significant urge changes and contextual variables

	γ_{00}	γ_{10}	*t*	*p*
D-pre – D-base	1.85		7.92	<.001
TA-pre – TA-base		.06	2.26	.02
AF-pre – AF-base		.10	2.32	.02
Post-meal		.40	5.00	<.001
Post-sex		.49	3.72	<.001
Social venue		.31	2.97	.003
D-post – D-pre	-3.02		-20.81	<.001
Social venue		.23	2.04	.04

D-pre – D-base = Change in desire from baseline to pre-smoking state. *D-post – D-pre* = Change in desire from pre- to post-consumption state.

TA-pre – TA-base = Variability in tense arousal from baseline to pre-smoking state. *AF-pre – AF-base* = Variability in anger/frustration from baseline to pre-smoking state

Note. Mean unstandardised coefficients are in the columns labelled γ00 and γ10.

Baseline to pre-smoking desire covariation

Craving was elevated in pre-smoking responses as compared with baseline. Succeeding analyses examined this change (D-pre - D-base) in relation to change scores for mood. Desire change was not related to either EA-pre - EA-base or HT-pre – HT-base, but was significantly related to variability in anger and tense arousal between baseline and pre-smoking states (variability that did not reach significance in earlier analyses). Elevation of desire was greater in episodes where tense arousal and/or anger/frustration were greater (relative to baseline mood levels).

Further analyses examined contextual covariation with D-pre - D-base. Elevation of urge was increased when smoking episodes occurred after eating, after sex, and whilst in a social venue. No other contextual variables were uniquely predictive of D-pre – D-base.

Pre- to Post-smoking desire covariation

The desire to smoke decreased significantly following consumption. Succeeding analyses examined this change (D-post – D-pre) in relation to change scores for mood, but no significant relationships were found. When the influence of D-pre – D-base was examined, it was found that satiation was greater in episodes where pre-smoking craving had been greater (γ_{10} = -.67, t = -13.15, p < .001) relative to baseline.

Further analyses examined contextual covariation with D-post – D-pre. Cessation was reduced when smoking episodes occurred in a social venue. No other contextual variables were uniquely predictive of D-post – D-pre.

5.3 Discussion

As predicted, mood was altered in relation to smoking episodes. Of the three models tested, the Incentive-Sensitisation model was supported. Further, consonant with hypotheses, BAS-related mood dimensions (specifically, hedonic tone and energetic arousal) were most operative in this Incentive-Sensitisation pattern. Desire to smoke showed the expected pattern of change: increasing before smoking and decreasing immediately after. However, contrary to prediction, desire was not related to the operative mood dimensions (hedonic tone and energetic arousal). Finally, analyses identified some situational correlates of the smoking-related changes in mood and craving. It was anticipated that such sensitivity to context would be apparent. However, precise predictions about covariation could

not be specified due to the paucity of previous research in this regard. Despite this, the nature of identified relationships appears to present a consistent picture – especially for mood-context relationships. Pre-smoking boosts in hedonic tone are greater in more pleasurable situations (for example. when socialising or drinking alcohol); pre-smoking boosts in energetic arousal are dampened in relaxed contexts (when resting/at home).

5.3.1 Mood-Smoking and Model-Fit

The general trend in mood change between states suggests that positive mood (specifically, as predicted, hedonic tone and energetic arousal) increases in the cued anticipatory state before smoking, but is not additionally elevated in the state immediately post-consumption. Such a pattern is emblematic of an incentive-sensitisation conceptualisation of drug-related changes in mood (Robinson & Berridge, 2000): positive mood increases in association with the approach behaviour (preparation to smoke) but is unaffected by the direct effects of smoking.

Initial analyses of mood changes in relation to representative functions indicated that - for both energetic arousal and hedonic tone - models predicting an increase in positive mood from baseline to pre-smoking state were best-fitting. These analyses suggested that pre- to post-smoking changes for these mood dimensions were less consistent, however: functions representing both appetitive-incentive and incentive-sensitisation models could be fitted, with little difference in goodness of fit. Subsequent MANOVA and HLM analyses demonstrated that hedonic tone and energetic arousal did not change from pre- to post-smoking – only change from baseline to pre-smoking was significant.

What does the emergence of an incentive-sensitisation model of mood regulation by smoking suggest? Firstly, that smoking may not regulate mood/affect motivation

directly – as would be postulated within appetitive-incentive and associative-withdrawal frameworks of reinforcement (Markou *et al.*, 1993). The direct effects of smoking may be important in confirming consummating anticipation, however: it is likely that the positive effects of smoking expectancies/cues become inverted if smoking fails to occur (Schultz, 1998); this would lead to a negative change from pre- to post-smoking, but such a pattern was not evinced in the present research. If incentive value becomes sensitised (such that smoking cues acquire motivational salience), habituation to direct effects may not be sufficient to extinguish reinforcement or alter perceptions of mood-regulatory effects. The incentive-sensitisation model posits that incentive effects may be partly implicit and of limited availability to subjective report (Berridge & Robinson, 1995), but the present findings support the notion of incentive effects on self-reported mood (elevation of positive hedonic and energetic states). Such effects could contribute to (explicit) beliefs about smoking as a mood-regulator in the absence of direct consummatory effects.

Could it be that direct effects were not evident in the present study because they manifest a little while after smoking (and elicited post-smoking reports)? Evidence suggests that this is unlikely (Benowitz, 1990; Warburton, 1992). In deprived smokers, mood effects have been found immediately after smoking, but minimally so 10 minutes later (Perkins *et al.*, 1992). Subjective reports during smoking behaviour suggest that the duration of associated sensations is short and may dissipate before the end of a smoking episode (Pomerleau & Pomerleau, 1992). Could it be that direct effects were not evident because they manifest early in consumption and have reduced to pre-smoking levels by the time an episode is finished? Perhaps, although (in unreported analyses) pre- to post-smoking mood changes were examined as a function of time taken to smoke, and no significant relationships were found (these change scores were not significant, but may show significant covariability with other measures). It is likely that consumption-related

mood changes would show sensitivity to episode length if the answer to this question is in the affirmative.

A second implication – following from the first - is that consumption substitutes (e.g., nicotine replacement therapies) may have limited efficacy. Such substitutes could aid coping with consequences of abstention from smoke consumption, such as nicotine withdrawal - although secondary effects of smoke consumption (e.g., sensory sensations of inhalation; Russell *et al.*, 1975) might be harder to compensate for. However, current findings suggest that consumption *per se* may have less motivational significance than cues to smoke – at least in terms of mood effects – with the implication that drug "wanting" in the presence of drug cues (Robinson & Berridge, 2001) may not be attenuated by consumption substitutes. An association between mood enhancement and the initiation of smoking (smoking-specific cues and expectations) implies that consumption substitutes target the lesser component of motivation. This argument is somewhat supported by data indicating that relapse can occur long after withdrawal subsides (Somoza *et al.*, 1995), and in spite of nicotine replacement (Rose, 1996).

5.3.2 Specificity of mood change

Figure 5.3 depicts smoking-related mood changes. Discussion in this section pertains to this basic model.

Figure 5.3

Model of episodic mood-change

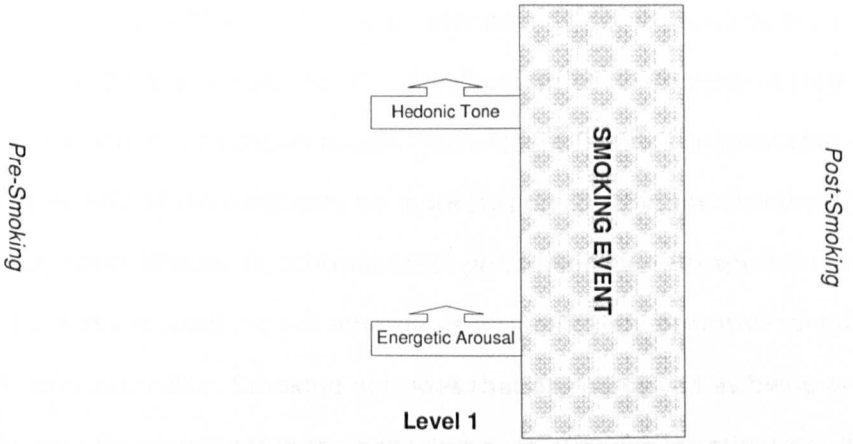


Figure 5.3 represents mood changes related to the onset and offset of smoking episodes. The shaded box represents the duration of smoking; time is loosely conceptualised as advancing from left to right in this figure. Thus, variables shown to the left of the box depict pre-smoking mood changes (from baseline). Episodes are preceded by increases in hedonic tone and energetic arousal. This is represented by the appropriate box-arrows; upward arrows are indicative of increased mood intensity in connection with smoking. Mood does not change from the pre- to post-smoking state.

The increase in positive hedonic tone associated with the cueing of smoking is partly consistent with prior research (e.g., Geier *et al.*, 2000). Some laboratory studies have found that positive hedonic tone *decreases* in response to presented smoking cues (Tiffany & Drobes, 1990; Drobes & Tiffany, 1997). But more recent research suggests that perceived drug availability (expectation to smoke) may moderate this effect: when signals for cigarette availability were present, cues elicited increases in positive hedonic tone (Carter & Tiffany, 2001). The latter design – and related results – may be a more appropriate reference for the current research. Present findings were derived from diary data reflecting everyday smoking patterns; participant reports were elicited in the environments where they usually smoke, and during periods of free-smoking without deprivation.

Elevation of energetic arousal in association with the cueing of smoking is somewhat consonant with evidence that smoking has stimulant actions - enhancing

attention and arousal (Sherwood, 1993; Warburton, 1992) - but not with the notion that these are direct physiological effects. Evidence further suggests that sensitisation to these energetic activation effects may occur (Soria *et al.*, 1996) – such that preconditions are met for the development of reinforcement through the supported incentive-sensitisation model. The present findings suggest that cued-anticipatory effects of smoking may be more responsible for any elevation of active arousal than direct effects. In contrast to its prominence in retrospective reports (chapter 4), tense arousal did not emerge as a significantly operative component of mood-smoking variability. Smoking episodes that are perceived as being prompted by anxiety may be prominent in memory, but such experiences might not be representative of common motivations in everyday smoking.

For both hedonic and energetic dimensions, mood change from baseline to pre-smoking state showed sensitivity to episodic context.

5.3.3 Mood-Smoking and Contextual Variability

Figure 5.4 shows smoking-related mood-changes in relation to contextual covariates. Discussion in this section pertains to this model.

Figure 5.4

Model of episodic mood-change covariation

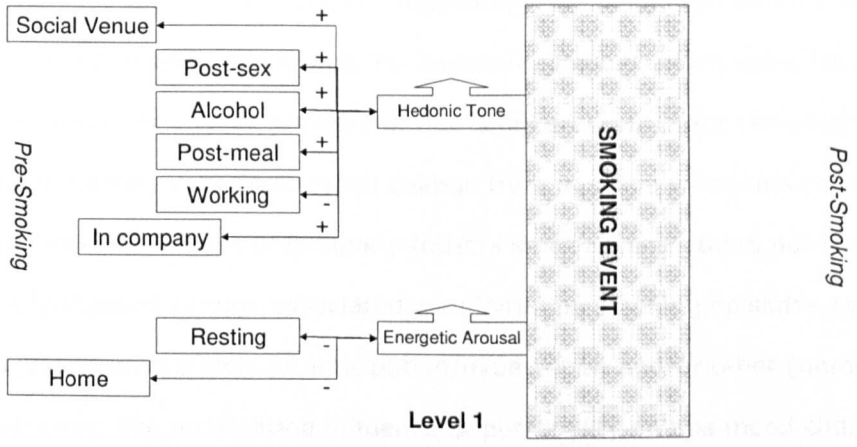


Figure 5.4 represents episodic mood changes in relation to contemporaneous situational conditions. Variables shown to the left of the smoking event depict pre-smoking slopes between mood changes and contextual variables. For example, smoking-related increases in hedonic tone were enhanced after sex, and this is depicted by the positive connection (denoted by link-adjacent valence symbol) between hedonic tone and the post-sex state. Directionality of these slopes could not be determined by present methods, and this is reflected in the use of bidirectional connective arrows. Further to post-sex enhancement, pre-smoking hedonic boosts (from baseline) are greater when drinking alcohol, in the company of others, in social venues, and after eating; hedonic incentive effects are attenuated in the context of work/study. Increases in energetic arousal are less pronounced when at home and whilst in a restful state.

It has been suggested that mood-regulatory effects of smoking may show dependence on situation (further to dependence on individual variability; Gilbert, 1997). Identified covariation between smoking-related mood changes and contextual variables supports this notion, indicating that the associative effects of smoking on mood are partly state-contingent (and so do not reflect anticipation alone). This is consonant with the supported incentive-sensitisation model (Berridge & Robinson, 1995): certain situational smoking cues appear to increase positive mood relative to normal levels in a way that may enhance the incentive value of smoking. Although there was overlap between situational cues (for example, alcohol consumption tended to occur in social venues towards the end of the day)

the identified contextual variables demonstrated independent relationships with mood change. Furthermore, mood changes remained significant when modelled as joint functions of identified predictors, suggesting that smoking-related effects on mood are not completely situational. For example, most smoking episodes (62.1%) occurred in company (either smokers or non-smokers), but there remained significant variability in hedonic mood change from baseline when this change score was modelled as a function of company (others smoking and others not smoking). It may be that mood change associated with initiating smoking episodes also reflects episode-level effects of anticipation/expectation and/or other (unmeasured) contextual cues. The moderating influence of personality on this mood change is considered in Chapter 6. A better understanding of the specificity of relationships between contexts and mood-smoking associations (rather than simply context-mood associations) was obtained in the analysis of comparative consumption data from the diary of food consumption (see Chapter 7). These analyses indicated that hedonic elevation is not evident in eating; even when analysis is limited to eating episodes that occur in company, hedonic mood is not shown to change from baseline (i.e., smoking is the key element in smoking-company interactions with hedonic elevation).

Baseline to pre-smoking hedonic covariation

Positive hedonic elevation from baseline to pre-smoking showed sensitivity to various situational conditions. Being accompanied by others appears to have an agonistic effect on hedonic elevation, whether or not those present were also smoking. The presence of others smoking may have exposed respondents to strong smoking-specific sensory cues (Best & Hakstian, 1978) and social-participatory incentives to smoke (Conrad *et al.*, 1992). Such cues may have increased approach activity (indexed by positive hedonic effects), and thus encouraged smoking behaviour. The presence of others not smoking had similar effects, suggesting a general social effect on smoking-related mood enhancement. This may relate to

research indicating that smoking and socialising are strongly linked behaviours from the onset of smoking through to maintenance and attempted cessation (Wills & Vaughn, 1989; McKennell, 1970; Royce *et al.*, 1997): being with others enhances anticipatory smoking effects, and could develop into a trigger for smoking and relapse.

A related finding was that pre-smoking hedonic elevation was greater for episodes occurring in a social setting (bars, clubs, and restaurants). The literature indicates that smoking may be particularly associated with these locations (Marlatt *et al.*, 2002), and such environments emerged as salient smoking triggers in the initial study of the present research. These environments may have exposed respondents to sensory cues (smoky atmosphere) and may have particular hedonic value as places associated with leisure-oriented social encounters and other potentially rewarding behaviours (eating, drinking alcohol).

In evaluating the affective impact of smoking, Gilbert (1995) emphasised a need to investigate hedonic smoking-effects in relation to consumption of other substances (alcohol, coffee, food, etc.) and "times of special enjoyment" (p. 14) – such as after sex. The present findings suggest that these situations are associated with increased elevation of positive hedonic mood (from baseline) – smoking episodes occurring whilst consuming alcohol, post-sex, or post-eating were initiated in a happier state, relative to others. Within the context of the supported incentive-sensitisation model, this finding suggests that these activity states are particularly strong cues for incentive-based enhancement of mood. Conversely, work or study-based activity was associated with dampened hedonic elevation from baseline, and smoking in these situations may reflect different motivational processes.

The finding that pre-smoking happiness was greater (relative to baseline) in episodes that occurred later in the daily smoking sequence might best be

interpreted in one of two ways. Firstly, it may be that effects of smoking on mood are cumulative such that later episodes reflect a build-up of positive hedonic cueing. It has been found that nicotine levels (with a half-life of two hours) are typically built-up in this way over a day of smoking (Benowitz *et al.*, 1982), but the present findings indicated that nicotine ingestion had no significant enhancing effects on mood. Pre-smoking mood levels at least seemed to persist to the end of smoking episodes (no significant negative changes were found), and may only gradually decline such that subsequent episodic boosts to hedonic mood produce a linear trend of improvement from baseline Perhaps nicotine is related to the *maintenance* of cued/anticipatory mood elevation between episodes? The duration of any effects of smoking-related cues or nicotine consumption on mood has received little investigation (Gilbert, 1995). Secondly, and perhaps more parsimoniously, it could be that this trend reflects natural diurnal mood change (Stone *et al.*, 1996): pleasant mood tends to be higher in the evening (though there is individual and situational variability in this propensity). This interpretation is somewhat bolstered by the absence of relationship between smoking latency and hedonic mood change; if mood development over the course of daily smoking is represented by episodic peaks and gradual inter-episodic decline, a measure of time since last smoked should covary with affective measures. Consistent with opponent-process findings (Diener *et al.*, 1991; Solomon, 1980), mood may actually demonstrate sharp reactivity to onset and offset of smoking cues. Positive hedonic elevation might be rapidly counteracted after smoking episodes back to normal levels for the current diurnal stage – in a way that could jointly explain the effect of serial position and non-effect of time since last smoked.

Baseline to pre-smoking energetic covariation

Positive energetic elevation from baseline to pre-smoking showed sensitivity to activity-state and location; this effect was attenuated by resting/passive behaviour and by being at home. These relationships might be expected for states that require minimal alertness and wherein there are likely to be fewer external arousing stimuli. It has been proposed that effects of smoking on hedonic and other affective dimensions might be mediated by its effects on energetic arousal and attention (Kassel, 1997; Gilbert & Gilbert, 1998). Being focused on current tasks, for example, may improve mood – partly, perhaps, by directing attention away from more distal worries and facilitating goal-obtainment in the present situation. However, this potential mechanism has been specifically attributed to the effects of nicotine (Kassel & Unrod, 2000). In light of present findings, this mediational relationship could only be implicated if arousing effects become associatively transferred to smoking cues and anticipation.

Yet modelling of current data suggested that most of the identified contextual cues were directly related to hedonic change, and only medially related to energetic change. That cueing of smoking in restful and secure contexts *is* directly associated with (reduced) energetic change is consonant with the argument that effects related to smoking are dependent on situation in a way that reflects an individual's goals in that situation (Gilbert, 1997). Cues to smoke in passive, disengaged states should demonstrate a reduced tendency to promote energetic arousal, as alertness may not be facilitative of desired experiences in these contexts - and is less likely to become associated with incentive to smoke in these contexts.

5.3.4 Craving and its relation to mood and context

Figure 5.5 shows episodic craving and observed covariation. Discussion in this section pertains to this model.

Figure 5.5

Model of episodic craving and covariation

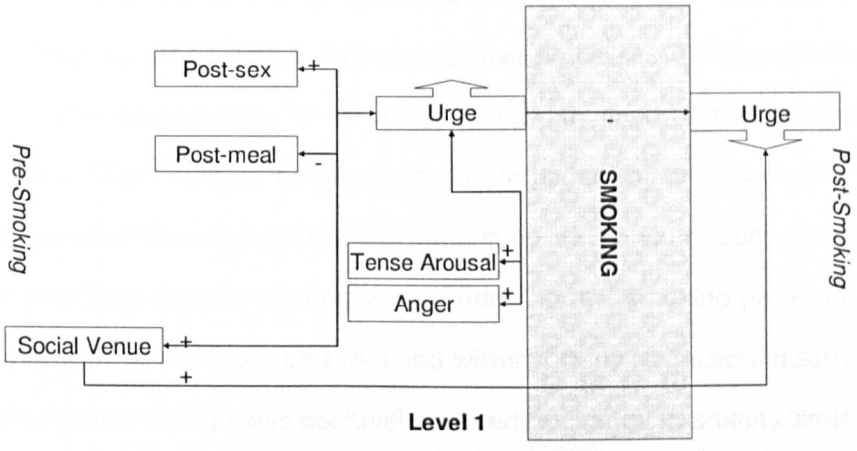


Figure 5.5 represents episodic urge-changes and covariation. Craving changes significantly from baseline to pre-smoking and additionally from pre- to post-smoking. Box-arrows show increased urge before smoking (left of the smoking event) and decreased urge after smoking (right of the event). Links between these urge changes and other variables show observed contextual reactivity. For example, pre-smoking increases in craving were enhanced after sex, and this is depicted by the positive connection between urge and the post-sex state. Further to post-sex enhancement, pre-smoking urges (increases in desire to smoke from baseline) are greater when in social locations (clubs, bars, restaurants, and so forth) but attenuated following food consumption. In terms of covariation with mood, greater urge intensity is associated with elevated anger and tense arousal before smoking. The extent of post-smoking urge-relief shows dependence on preceding state: greater pre-smoking desire is followed by greater assuagement by smoking. Urge-relief can be modified by locale however: satiation is reduced when smoking occurs in a social venue (despite the fact that this context is also associated with stronger pre-smoking urge elevation).

An expected pattern of desire to smoke was observed: craving increased from baseline to pre-smoking state, and smoking had palliative effects on craving (Halikas, 1997). Smoking exhibited a dose-response effect on cessation, with greater reduction of desire by smoking in episodes where pre-smoking desire was greater. Interestingly, although desire and mood showed similar directions of

change from baseline to pre-smoking (at a general level), elevation of desire was not related to elevation of positive hedonic or energetic affect.

Self-reports of urge have heterogenous origins (Tiffany, 1997; Toneatto, 1999b; Merikle, 1999), and may reflect various cognitive processes. Tiffany (1995) has argued that processes related to normal smoking may operate independently of craving unless these automated processes are impeded (by environmental obstacles, or conscious intervention between cues and consumption). If the identified cued/anticipatory mood changes index normal smoking patterns, a lack of relationship with desire could be explained within Tiffany's conceptualisation. The finding that desire change was positively related to change in anxiety and/or irritation further supports this rationale, and replicates mood-urge relationships reported in a diary study by Delfino *et al.* (2001). These mood dimensions (though not found to significantly change, as an overall trend, within present observations of everyday smoking without deprivation) may be more sensitive to obstructed smoking and frustrative non-reward, and so relate more to desire to smoke. Findings of the current research relating to abstinence in the quasi-interventional study (discussed in Chapter 8) appear to support this notion.

Overall, the inter-relation of mood and craving observed presently is most consonant with a recent study by Carter and Tiffany (2001). They reported an experiment wherein smoking cues simultaneously increased both positive affect and craving, but craving was only correlated with changes in negative affect. Clearly, this finding closely parallels the present finding: BAS-related (positive) mood and desire to smoke were elevated concurrently, but desire to smoke only covaried with (BIS-related) tense arousal and anger. The experiment by Carter and Tiffany (2001) differed from the majority of laboratory studies as participants were tested in a context where they could smoke and access cigarettes. The more naturalistic conditions surrounding this experiment (regarding expectation to smoke/substance

availability; Dols *et al.*, 2002) may help to explain its agreement with present findings.

Though desire to smoke did not relate to observed hedonic and energetic mood, craving was increased in some contextual states that were also associated with increases in the positive valence of these mood dimensions. Specifically, pre-smoking desire was greater after sex, after eating, and when in social venues (bars, clubs, or restaurants). This is consistent with findings indicating that different reward behaviours may have cross-over potentiating effects (e.g., Henningfield *et al.*, 1990; Taylor *et al.*, 2000), such that desire for/experience of one rewarding behaviour (sex, food consumption) may increase desire for another (smoking). Considering the metacognitive nature of craving (Tiffany, 1997), increased desire in social venues may reflect a complex combination of social coping, behavioural contingencies, and protection against anxiety (Shadel *et al.*, 2001).

5.4 Next chapter

Chapter 6 extends the findings in this chapter by examining the moderating influence of trait factors. The hierarchical models in the present chapter are made conditional at level 2 and re-analysed. In this way, Chapter 6 investigates the direct influence of personality on incentive mood changes, craving changes, and on the slopes between mood/craving and context. Moreover, individual differences in model-fit are examined: to uncover potential trait-based dispositions towards the development of one reinforcement model over another.

Chapter 6. Moderation of mood and episodic correlates

The main aim of the current chapter was to explore if personality (particularly, BIS/BAS dimensionality) moderated the best fitting mood-smoking model (the incentive-sensitisation account) identified in the previous chapter. As predictions about moderation of episodic smoking motivation were contingent on the nature of findings in the previous chapter, there is presently an opportunity to better specify original hierarchical hypotheses.

Findings in Chapter 5 permit a more confident prediction that BAS-related traits moderate mood-smoking experiences. Smoking-related mood changes were observed for hedonic tone and energetic arousal, and these mood dimensions are theorised to be regulated by the BAS (Carver & Scheier, 1998). Greater BAS should dispose greater sensitivity to reward and reinforcement learning (Pickering, Corr, & Gray, 1999; Zinbarg & Mohlman, 1998; Carver & White, 1994), so it was hypothesised that high-BAS individuals would have heightened incentive effects – relatively enhanced hedonic and/or energetic elevation before smoking. However, it was also noted that some researchers predict an opposite effect: low BAS individuals gain minimal pleasure from everyday situations (Loas, 1996), so they should experience stimulation from smoking most strongly (Cook *et al.*, 2004). Moderation of mood-context covariation (where present) was expected to be in line with direct moderating effects: again, BAS should dispose greater conditioning, resulting in stronger reactivity between contexts and mood change (such as drinking alcohol and hedonic elevation).

Although Chapter 5 indicated that the incentive-sensitisation model is the model that best describes mood effects for smokers as a whole, people may differ in the particular theoretical model that fits their experiences (according to their personality). Analyses of individual model-fit moderation were expected to bolster

other findings for moderation but also uncover different trait-based tendencies in an exploratory way – there may be systematic personality differences between individuals in the model that best describes their experience of smoking (for example, smokers low in emotional stability may tend more towards associative-withdrawal mood regulation). Analyses of individual differences in model-fit are, by necessity, exploratory in nature; there is a paucity of theory and empirical evidence to guide hypotheses in this regard (McMahon, 1999). It is reasonable, however, to suggest that a person's disposition may influence their behaviours and experiences over time such that they are more likely to encounter/develop certain types of reinforcement over others (Ten Berge & De Raad, 2002)

Although there is likely to be important systematic individual variability in craving experiences (Verheul, Brink, & Geerlings, 1999), and exploration of such variability has been encouraged (Cox *et al.*, 2001), few studies have considered craving moderation (Zilberman, Tavares, & el-Guebaly, 2003). The present research makes a novel exploratory contribution in this regard. One finding that may be applicable here in guiding prediction is that alcohol craving has been linked to the BAS Drive construct: with higher scorers reporting stronger desire to drink (Franken, 2002).

In summary, this chapter had the following aims:

1. To assess potential individual differences in mood-smoking relationships, examining:
    a. Moderation of episodic mood changes from baseline to pre-smoking, and pre- to post-smoking. It was predicted that high BAS individuals would experience greater elevation of hedonic tone/energetic arousal before smoking.
    b. Situational dependencies of mood moderation. It was predicted that high BAS individuals would be more sensitive in their mood-context reactivity. For example, relative to those with low BAS sensitivity,

they should exhibit a stronger tendency to experience greater pre-smoking hedonic boosts when drinking alcohol.

c. Moderation of individual fit to the three potential models of mood-smoking under test. For example, do high-BAS individuals show a greater tendency to experience an Incentive Sensitisation pattern of mood-smoking than their low-BAS counterparts? If so, do low-BAS individuals tend towards a different model of mood-smoking?

2. To uncover latent moderation of episodic craving changes and of their relationship with mood and contextual variability. For example, do differences in BAS level dispose differences in satiation of urge to smoke?

6.1 Investigatory approach

Initial analyses looked at individual differences in the mood-smoking models examined in the previous chapter; these proceeded in three stages. Firstly, episodic mood changes were modelled as a function of trait variables to identify moderators. Moderators identified at this stage were subsequently entered into slope models – to see if they influenced covariation between mood changes and episodic context. Thirdly, the model-fit analyses of the previous chapter – wherein mean mood scores (at baseline, pre-smoking, and post-smoking) were fitted to estimated change functions representing the theories under test – were also extended at level 2, so that trait moderation could be identified. Final analyses in this chapter examined desire changes and related episodic variability as a function of trait variables. In this way, the main aims of the present chapter were addressed sequentially.

Analyses in this chapter examined combined data-sets from the smoking diary and quasi-interventional diary (only episodes outside the intervention period were used in this analysis). These data sets were combined as they both contained

information relevant to the questions explored in this chapter, and were equivalent in terms of procedure and variables assessed. The merging of these data-sets yields more power for examining the central questions of this thesis: those concerning smoking in relation to mood (chapter 5) and personality (this chapter).

6.1.1 Moderation of episodic mood changes

Within-person mood changes identified in the previous chapter were analysed at this stage to determine variation as a function of trait-level individual differences (at level 2). For example, did changes in hedonic mood from baseline to pre-smoking vary as a function of people's trait BIS sensitivity? Such questions were examined with the following model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\,(\text{TRAIT}) + u_{0j}$$

In this model, whether a specific trait moderated mood-change was tested by the significance of the γ_{01} coefficient. Parallel models were constructed for hedonic and energetic mood changes from baseline to pre-smoking. Analysis of direct mood moderation was limited to change scores identified in the previous chapter. The potential moderating effects of the following person-level variables were examined: the three subscales of BAS (reward responsiveness, fun-seeking, drive), BIS, B5 trait-scores (Surgency Agreeableness, Conscientiousness, Emotional Stability, Intelligence), dependence (as measured by the Revised Tolerance Questionnaire), readiness to change (perceived addiction, desire to change, ability to change), smoker history/typology (initiation, stability, heaviest frequency, quit attempts, social prevalence, social pressure), and demographics (age, gender). Table 6.1 presents all measures used and their subscales. These formed level 2 variables; level 1 remained the same (see Chapter 5).

As some person-level measures may be correlated, it is possible that level 2 variables identified as moderators in individual analyses may not moderate changes at level 1 independently. To check moderator independence, all significant moderators of level 1 outcome slopes were re-analysed (after establishing individual significance as moderator) with significantly correlated measures entered together into each model.

Table 6.1

Administered trait measures (level 2 variables)

BIS/BAS	*Big Five*	*Dependence*	*Baseline Craving*	*Readiness to Change*	*Smoker History*	*Demographics*
BASDRV	S	RTQ	QSU1	Perceived addiction	Initiation	Age
BASRR	A	Observed rate	QSU2	Desire to change	Stability	Gender
BASFUN	C			Confidence in ability	Heaviest rate	
BIS	ES				Social exposure	
	I				Quit attempts	
					Social pressure	

S = Surgency, A = Agreeableness, C = Conscientiousness, ES = Emotional Stability, I = Intelligence.

BASDRV = Behavioural Approach System Drive, BASRR = BAS Reward Responsiveness, BASFUN = BAS Fun-Seeking, BIS = Behavioural Inhibition System.

RTQ = Revised Tolerance Questionnaire score, QSU1 = Positive Craving (Factor 1) score, QSU2 = negative craving (factor 2) score.

Table 6.1 presents the level 2 variables that were examined in relation to variability at level 1 of smoking models. Variables are organised in seven columns, though they can be thought of as belonging to three broader categories: personality (columns 1 and 2), smoker-specific variables (columns 3-6) and demographics (column 7). The most important variables for the present research were the BIS/BAS markers in the first column, followed by the Big Five trait dimensions in the second column (i.e., personality variability). Other variables were largely used descriptively.

6.1.2 Moderation of mood-context covariation

Further to examination of direct moderation of mood change-scores, it is important to investigate the extent to which individual differences influence within-person relationships. Identified covariation between context and mood change may vary as a function of person level variability. Such complex interactions of between- and within-person variance are amenable to analysis in multilevel models.

To determine if episode-level relationships described in Chapter 5 were moderated by individual differences, slopes from level 1 models were analysed at level 2 using a model similar to person-level models described above. For example, to establish whether relationships between hedonic change from baseline and others smoking varied as a function of trait scores, the following model was analysed:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\,(\text{TRAIT}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}\,(\text{TRAIT}) + u_{1j}$$

In these models, whether a specific trait moderated the HT1-base-others smoking relationship was tested by the significance of the γ_{11} coefficient. Similar models were constructed for all identified combinations of covariation between mood changes and contextual variables. Individual differences in slopes that were not significantly different from 0 (on average) were not analysed (due to the multiplicity of potential combinations), although it is acknowledged that there may be significant variability in a slope even when mean slope did not significantly differ from 0. Only person-level variables identified as direct moderators of mood change (in the preceding analyses) were examined as potential moderators of slopes for mood change and context.

6.1.3 Individual differences in model-fit

Thusfar, models from the previous chapter have been extended at level 2 to investigate moderation of episodic mood change-scores and related context slopes. Further analyses were conducted to explore individual differences in model-fit; building on initial analyses of mood-model covariation from the previous chapter. These analyses were intended to gauge individual trends in model experiences. Although the incentive-sensitisation model has received support as a general representation of smoking-related mood-regulatory experiences, there may be individual differences in model-fit tendencies that are masked in examination of significant change-scores alone.

A series of models were constructed to examine moderation of individual relationships between mean mood and estimated change functions representing the theories under test (Appetitive Incentive, Associative Withdrawal, and Incentive Sensitisation). Only hedonic tone and energetic arousal were examined in these analyses. Moderation of model-fit slopes for these dimensions was examined for all person-level variables (refer to Table 6.1).

6.1.4 Moderation of craving and its relation to mood and context

Final analyses in this chapter pertained to moderation of desire to smoke and its covariation with mood and context. The programme of modelling applied was similar to that followed for investigation of mood-change moderation.

Initially desire-change scores (baseline to pre-smoking and pre- to post-smoking) were modelled as a direct function of level-2 variability (see Table 6.1; baseline craving was not entered into these analyses, as desire-change scores partially derive from these scores). Correlated moderators were re-analysed (in a saturated model) to check independence. Subsequent models analysed person-level

moderation of relationships between desire-change and other episodic variability (mood changes and contextual variables). These relationships were identified in Chapter 5. Only person-level variables that were significant direct moderators of desire change were entered into models of slopes for desire-change.

6.2 Results

6.2.1 Moderation of episodic mood changes

The present analyses examined relationships between the degree of mood change and person-level variation. Mood changes from pre- to post-smoking were not significant and were not examined in relation to person-level variation. Moderation of hedonic tone is examined first, followed by moderation of energetic arousal. The results of these analyses are summarised in Table 6.2.

Baseline to pre-smoking hedonic moderation

Hedonic change was negatively related to scores on the reward responsiveness subscale of BAS (BASRR; γ_{01}= -.19, t= -3.42, p = .001) and to surgency (S; γ_{01}= -.04, t= -5.12, p < .001). No other level 2 variables were found to moderate hedonic change. However, BASRR and S were correlated (.30), suggesting that the identified moderating relationships may not have been independent. When these variables were entered together, only BASRR remained significant. The influence of surgency may be mediated by reward responsiveness (as an index of behavioural approach sensitivity). Thus, contrary to predictions, people with lower reward sensitivity tend to experience greater elevation of hedonic tone.

When total UMACL baseline score for hedonic tone (HT; γ_{01}= -.23, t= -13.98, p = <.001) was entered concurrently with BASRR at level 2 of this model, both variables remained significant. This implies that the effect of reward responsiveness

on pre-smoking hedonic change is not fully dependent on the influence of baseline hedonic tone - despite correlation between reward responsiveness and hedonic tone at baseline. People high in BAS sensitivity exhibit attenuated hedonic elevation in response to episodic smoking cues/expectation, and these effects persist over and above change-retarding effects of trait-related baseline mood.

Baseline to pre-smoking energetic moderation

Energetic change was negatively related to emotional stability (ES; γ_{01}= -.05, t= -3.21, p = .002). No other level 2 variables moderated this change. People with greater emotional stability tended to experience reduced elevation of energetic arousal.

When baseline energetic arousal (EA; γ_{01}= -.23, t= -13.98, p = <.001) was entered concurrently with emotional stability at level 2 of this model, only EA remained significant. This implies that the effect of emotional stability on pre-smoking arousal change is mediated by its influence on baseline arousal. People high in emotional stability generally experience more energetic arousal (as captured at baseline), such that their alertness is less responsive to the onset of smoking episodes.

Table 6.2

Person-level moderators of significant mood change

	γ_{01}	*t*	*p*
HT1-base			
BAS Reward Responsiveness	-.19	-3.4	.001
Surgency	*-.04*	*-5.1*	*<.001*
EA1-base			
Emotional Stability	*-.05*	*-3.2*	*.002*

HT1-base = Change in hedonic tone from baseline to post-smoking state. *EA1-base* = Change in energetic arousal from baseline to pre-smoking state.

Note. Mean unstandardised coefficients are in the column labelled γ01. Moderating relationships that remained significant after entry of baseline mood are in bold typeface, moderators with shared variance are in italics. Bold, non-italicised coefficients thus denote moderation of pre-smoking mood that is specific and independent.

6.2.2 Moderation of mood-context covariation

The second main aim of this chapter was to investigate the extent to which individual differences moderate covariation between context and mood change. The present analyses examined level-1 slopes (identified in the previous chapter) as a function of level-2 variables. Only level-2 variables identified as significant direct moderators of mood change in preceding models were examined in these analyses. Moderation of slopes for hedonic tone is examined first, followed by moderation of slopes for energetic arousal.

Baseline to pre-smoking hedonic covariation

The only within-person relationship that was moderated by a trait was the positive slope between others (not smoking) and hedonic change. The strength of the relationship between being in the company of others (not smoking) and hedonic elevation was negatively related to reward responsiveness scores (γ_{11}= -.08, *t*= -

2.11, p = .03). People high in reward sensitivity are less reactive to the presence of others in their hedonic change from baseline to pre-smoking state.

Baseline to pre-smoking energetic covariation

Within-person relationships involving energetic elevation (including covariation with hedonic change from baseline) were not moderated by level-2 variability.

6.2.3 Individual differences in model-fit

Analyses of mood change across states (baseline to pre-smoking and pre- to post-smoking) indicated an overall trend reflecting incentive-sensitisation mechanics of hedonic and energetic motivation. The present analyses examine individual differences in model-fit: assessing trait-based regulation of mood functions across the three states (whilst acknowledging the general pattern of incentive-sensitisation responding). Outcomes are level-1 slopes between model-functions and mood at each measurement point (for each episode). Moderation of slopes for hedonic tone is examined first, followed by moderation of slopes for energetic arousal.

Hedonic model-fit

The strength of appetitive incentive model-fit for HT was negatively related to BAS reward responsiveness (γ_{11}= -.01, t= -3.00, p = .003), emotional stability (γ_{11}= -.002, t= -2.11, p = .002), and negative craving (γ_{12}= -.02, t= -2.56, p = .01), and positively related to positive craving (γ_{11}= .01, t= 2.87, p = .005). People high in reward sensitivity and emotional stability are less likely to experience an appetitive incentive pattern of smoking-related mood than those low in sensitivity and stability. Those experiencing more positive craving and less negative craving at baseline tend towards experiencing the appetitive-incentive pattern. Neither craving measure is significant when entered alone; indicating that the shared variance of these constructs (general desire) is not related to the appetitive-incentive pattern.

Rather, the discriminatory components of these measures (negative versus positive craving) have predictive value. This interpretation is bolstered somewhat by the non-significance of the combination QSU score in these analyses of potential moderators.

Similar patterns of moderation were evident for incentive sensitisation model-fit. The strength of incentive sensitisation model-fit for HT was negatively related to BAS reward responsiveness (γ_{11}= -.02, t= -3.71, p < .001), emotional stability (γ_{11}= -.004, t= -3.87, p < .001), surgency (γ_{11}= -.005, t= -4.01, p < .001), and negative craving (γ_{12}= -.04, t= -3.22, p = .002), and positively related to positive craving (γ_{11}= .03, t= 3.36, p = .001). People high in reward sensitivity, extraversion, and emotional stability are less likely to experience an incentive sensitisation pattern of smoking-related mood than those low in sensitivity, surgency, and stability. Those experiencing more positive craving and less negative craving at baseline tend towards experiencing the incentive-sensitisation pattern. Again, neither craving measure is significant when entered alone. Observed moderators of fit to the incentive sensitisation model remained significant when correlated measures were entered together.

Energetic model-fit

The strength of associative-withdrawal model fit for EA was positively related to emotional stability (γ_{11}= .004, t= 2.44, p = .02). As the fit between EA and associative withdrawal was found to be negative in the previous chapter – indicating an actual trend towards inverted-U incentive sensitisation overall – this moderating relationship suggests that people high in emotional stability are more likely to experience the associative withdrawal pattern (hence, less likely to experience inverted-U incentive-sensitisation) than their neurotic counterparts. The strength of incentive sensitisation model-fit for energetic arousal was negatively related to emotional stability (γ_{11}= -.01, t= -5.69, p < .001), age (γ_{11}=

-.01, t= -2.85, p = .005), and heaviest rate of smoking (γ_{11}= -.004, t= -2.46, p = .01). People who are high in neuroticism, younger, and have a history of low-frequency smoking are more likely to experience an incentive sensitisation pattern of alertness, relative to those who are more stable, older and have a history of heavier smoking. These moderators were not inter-correlated, indicating independence.

Similarly, the strength of appetitive-incentive model-fit for EA was negatively related to emotional stability (γ_{11}= -.004, t= -4.69, p < .001), age (γ_{11}= -.01, t= -3.24, p = .002), and heaviest rate of smoking (γ_{11}= -.003, t= -2.36, p = .02). People who are high in neuroticism, younger, and have a history of low-frequency smoking are more likely to experience an appetitive incentive pattern of alertness, relative to those who are more stable, older and have a history of heavier smoking.

6.2.4 Moderation of craving and its relation to mood and context

The third main aim of this chapter was to examine person-level moderation of acute episodic changes in desire to smoke and of their relationship with mood changes and contextual variability at the same level. Moderation of desire change from baseline to pre-smoking is examined first, followed by moderation of change from pre- to post-smoking.

Baseline to pre-smoking desire covariation

Desire change (D-pre – D-base) was positively related to emotional stability (γ_{01}= .06, t= 2.59, p = .01), and negatively related to heaviest rate of smoking (γ_{01}= -.05, t= -2.37, p = .02) and RTQ dependence score (γ_{01}= -.07, t= -2.02, p = .04). No other level 2 variables were found to moderate desire change. However, heaviest rate and RTQ were correlated (.67), suggesting that the identified moderating relationships may not have been independent. Such a lack of

independence was confirmed when these variables were entered together: neither remained significant. This suggests that a latent construct reflected by the shared variance of these two measures was responsible for the individual relationships identified. Compared to people high in neuroticism, those with more emotional stability tend to experience greater smoking-contiguous elevation of desire from baseline. There is also evidence to suggest that high levels of an underlying dependence-related construct may dispose individuals towards more consistent levels of craving (attenuating change from baseline to pre-smoking).

When total baseline desire (QSU; γ_{01}= -1.06, t= -10.31, p = <.001) was entered concurrently with the identified potential moderators at level 2 of these models, only QSU remained significant. This implies that the effects of emotional stability and dependence history on pre-smoking desire change are mediated by their influence on baseline levels of craving. These traits influence craving as a general process - not simply in response to episodic cues/expectancy - such that acute changes preceding smoking reflect an individual's baseline desire. People high in neuroticism and dependence/history of heavy smoking may experience more generalised desire (as captured at baseline), such that their craving is less responsive to the onset of smoking episodes.

Further analyses examined moderation of contextual covariation with D-pre - D-base. No significant relationships emerged in these analyses.

Pre- to post-smoking desire covariation

Desire change (D-post – D-pre) was positively related to the drive subscale of BAS (γ_{01}= .23, t= 3.33, p = .001), and negatively related to emotional stability (γ_{01}= -.03, t= -1.95, p = .05). No other level 2 variables were found to moderate satiation. People high in behavioural approach drive and neuroticism experience less satiation than those with lower drive and more emotional stability.

When preceding desire change (D-pre – D-base; slope analysed in Chapter 5) was entered at level 1 of these models (concurrently with the identified potential moderators at level 2), emotional stability was no longer significant. This implies that the effect of emotional stability on satiation is mediated by its influence on pre-smoking desire elevation. People high in neuroticism experience less pre-smoking elevation of craving from baseline, and consequently experience less satiation of desire from smoking. Taken with findings of mediated moderation for D-pre – D-base, there is a suggestion that emotional instability may lead to a generalised state of high desire to smoke (compared to more stable individuals) such that craving levels are relatively insensitive to smoking cueing and consumption. In contrast, BAS sensitivity appears to moderate satiation responses directly, such that those with a high approach drive experience less attenuation of pre-smoking desire to smoke by consumption, as compared with their less driven counterparts.

Final analyses at this stage examined moderation of contextual covariation with D-pre - D-base. No significant relationships emerged in these analyses.

6.3 Discussion

With regard to the principal aims of the present chapter, the obtained results suggest:

1. In terms of individual variability in mood-smoking relationships:
    a. The critical component of episodic mood change is partly moderated by BAS sensitivity – however, the direction of this moderation is the opposite of that which was predicted. Emotional stability also moderates smoking-incentive mood (through its influence on general mood levels).
    b. Identified trait-based moderation is largely independent of situational contingencies. Where mood-context moderation by BAS is evident, the relationship again contradicts expectations.
    c. Although an incentive-sensitisation model of mood-smoking emerges overall, there are individual differences in model-fit tendencies (implying a need for individualised assessment).
2. Craving in normal smoking behaviour reflects a generalised process sensitive to emotional stability and dependence. Satiation experiences are specifically moderated by BAS sensitivity

6.3.1 Moderation of episodic mood changes

Figure 6.1 shows direct moderators of smoking-related mood changes. Discussion in this section pertains to this model.

Figure 6.1

Model of episodic mood-change moderation

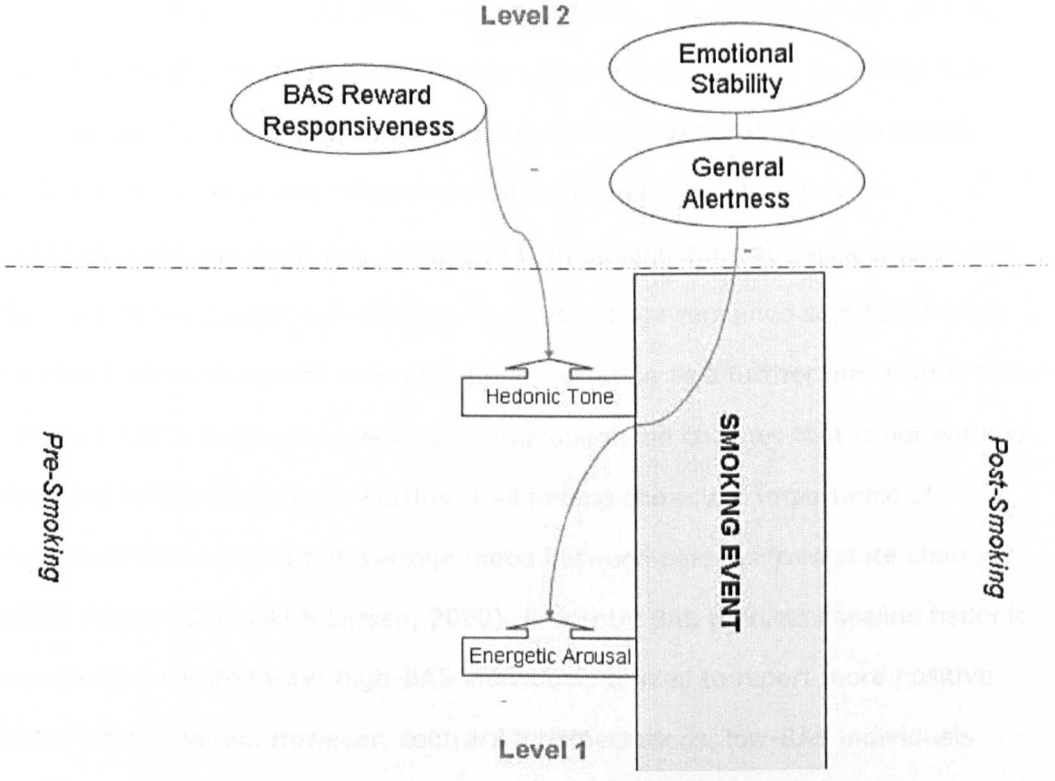


Figure 6.1 represents episodic changes at Level 1 of the model and stable moderators at Level 2. At level 1, the shaded box represents the duration of smoking; time is loosely conceptualised as advancing from left to right in this figure. Thus, variables shown to the left of the box depict pre-smoking mood changes (from baseline). Episodes were preceded by increases in hedonic tone and energetic arousal. This is represented by the appropriate box-arrows; upward arrows are indicative of increased mood intensity in connection with smoking. The direction of moderating relationships is shown by the symbols adjacent to connections from level 2 to level 1 variables. For example, the increase in hedonic tone prior to smoking is attenuated for individuals who are higher in BAS reward sensitivity.

As originally predicted, mood change was specifically moderated by BAS score – and was not moderated by BIS score (Pickering, 1997). Higher levels of BAS sensitivity (indexed by the reward responsiveness subscale) were associated with dampened hedonic elevation in the pre-smoking state. Evident antagonistic moderation of hedonic change from baseline to pre-smoking is incongruent with

theoretical predictions (and previous empirical findings that BAS sensitivity predicts positive affect in anticipation of rewards; Carver & White, 1994). However, individuals with greater BAS sensitivity (specifically, reward sensitivity) may be more hedonically responsive to everyday situations and stimuli, such that the anticipation of smoking does not elevate mood beyond baseline to the extent evident in those with lower BAS sensitivity (Cook *et al.*, 2004). Reward responsiveness was positively correlated with hedonic tone at baseline (.26, p = .02), but its moderating influence on hedonic change remained significant when baseline hedonic tone was entered into the equation as a further moderator. This suggests BAS influence on smoking-contiguous mood changes that is not entirely mediated by baseline mood. Further, this finding shows the importance of separating measurement of average mood between persons from state changes within person (Zelenski & Larsen, 2000). Presently BAS predicts baseline hedonic tone in the expected way: high-BAS individuals tended to report more positive hedonic tone overall. However, contrary to expectations, low-BAS individuals reported greater increases in positive hedonic mood in pre-smoking states.

BAS sensitivity is strongly related to extraversion (Pickering, Corr, & Gray, 1999; Depue & Collins, 1999), and the present findings may be reflective of Eysenck's conceptualisation of extraverts acting to counter depressions of hedonic tone (Eysenck & Eysenck, 1985). Extraverted (high-BAS) individuals might experience relatively more smoking episodes cued in a hedonic state that is less positive than their baseline level, when compared with their less extraverted (low-BAS) counterparts[2]. Indeed, recent research has indicated that high extraversion predicts drinking alcohol to cope with negative emotions (in addition to predicting drinking to enhance positive emotions; Cooper, Agocha, & Sheldon, 2000). Interpreted in terms of Eysenckian extraversion theory, observed BAS moderation may also reflect postulated heightened-reactivity to (low-intensity) stimuli in introverted

[2] This tendency was found in unreported idiographic analyses of episodes

(reward insensitive) individuals (Eysenck, 1967) – with smoking cues producing greater hedonic elevation in smokers of this personality-type.

The presence and selectivity of BAS moderation (evident in hedonic change, but not energetic arousal change) could imply individual differences in motivation to smoke. Low-BAS individuals may smoke more to experience hedonic elevation, and come to associate smoking with hedonic regulation more than high-BAS individuals (who experienced less hedonic change from baseline to pre-smoking in the present study). In contrast, anticipatory changes in energy and alertness might constitute a consistent incentive/trigger to smoke (stable across BAS-varying individuals) – although increases in arousal may have more motivational salience for high-BAS individuals, for whom they were not found to be attenuated in the way that concurrent hedonic changes were.

Although not moderated by BAS-related trait scores, a marker of individual differences in energetic change from baseline was identified in modelling of the Big Five personality dimensions. Those with higher levels of neuroticism tend to experience greater increases in energetic arousal before smoking. There is evidence to suggest that neurotic individuals might find smoking more arousing (McManus & Weeks, 1982; Gilbert, 1995), and these effects could condition to cues (Stewart *et al.*, 1984). Also of potential supportive relevance are studies of cue-reactivity in alcoholics and opiate users that have found neuroticism to be related to cue-elicited arousal (McCusker & Brown, 1991; Powell *et al.*, 1990). Present findings indicated that moderation of energetic arousal generalised across baseline and smoking-contiguous experiences. Pre-smoking elevation of alertness was predicted by baseline levels to the exclusion of emotional stability as a moderator. Greater emotional stability may dispose an individual towards greater vigilance across situations, such that pre-smoking processes produce less pronounced increases in arousal. Disposition of this kind could affect smoking-related mood changes in quite

an artifactual way. Alternatively (or perhaps additionally), smoking may have long-term effects on energetic arousal in more neurotic individuals, such that they tend towards a more sluggish state when not smoking. Smoking cues/anticipation could then elicit relatively stronger (compensatory) mood-change processes through an associative mechanism. In these potential interpretations, 'normal' levels of subjective arousal fully mediate individual differences in smoking-contiguous changes in arousal. Comparison consumption data from non-smokers may be facilitative in validating these (potentially mutually inclusive) interpretations (see Chapter 7).

Given that low emotional stability (high neuroticism) is theoretically reflective of combined BIS and BAS sensitivity (Pickering *et al.*, 1997), it is perhaps not surprising that this trait disposes reactivity to motivational stimuli (smoking cues). Previous research has shown that this trait can predict reactivity in both positive and negative affect (Murray, Allen, & Trinder, 2002) – consistent with the theoretical contribution of neuroticism to both BIS and BAS. Use of neuroticism measures is complimentary to assessment with the BIS-BAS scales of Carver & White (1994), as their purpose-built BAS scales do not reflect the theoretical contribution of neuroticism to BAS. Thus, observed moderation of energetic arousal by emotional stability (over and above the BAS traits) does not contradict the conceptual association of BAS with energetic arousal.

6.3.2 Moderation of mood-context covariation

Figure 6.2 shows moderators of smoking-related mood-change covariation. Discussion in this section pertains to this model.

Figure 6.2

Model of episodic mood-change covariation: extended to consider moderation

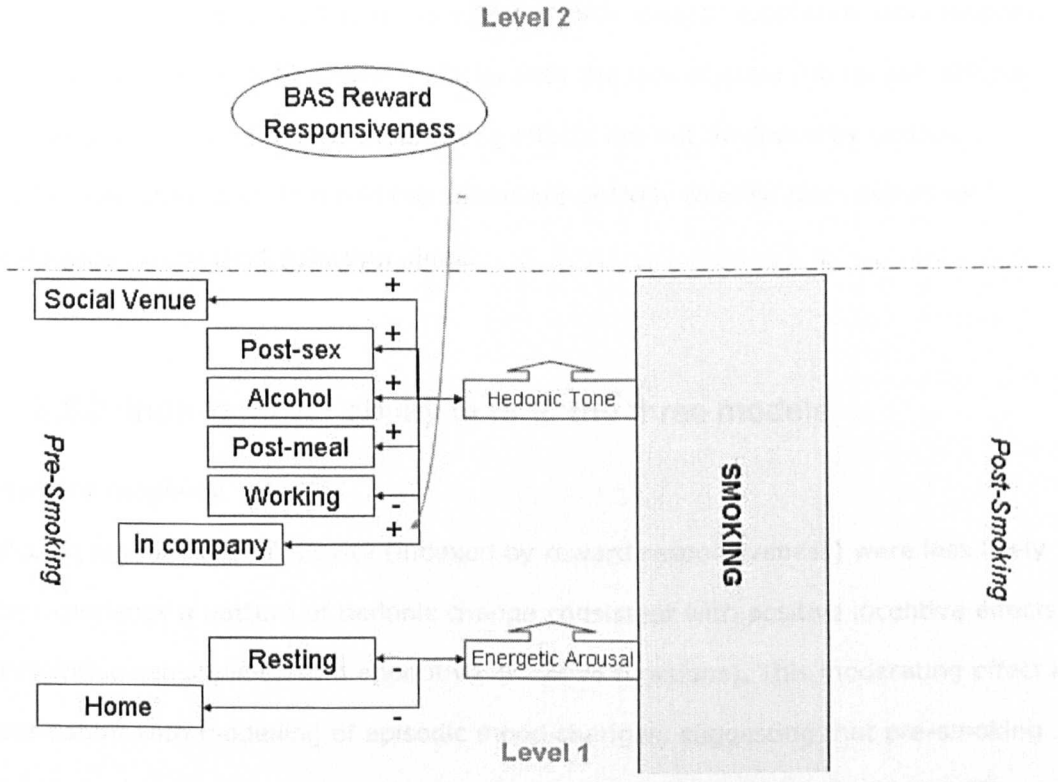


Figure 6.2 represents episodic change-covariation at Level 1 of the model and stable moderators at Level 2. At level 1, variables shown to the left of the smoking event depict pre-smoking slopes between mood changes and contextual variables. For example, smoking-related increases in hedonic tone were enhanced after sex, and this is depicted by the positive connection between hedonic tone and the post-sex state. As in the previous figure, the direction of moderating relationships is shown by the symbols adjacent to connections from level 2 to level 1 variables. The only covariation that was moderated at level 2 was the tendency towards greater hedonic boost when in the company of others. Positive reactivity between being in company and experiencing stronger hedonic incentive effects is attenuated for individuals who are higher in BAS reward sensitivity.

Examination of cross-level interaction effects on mood changes indicated that most situational effects identified in the previous chapter were independent of personality moderator effects. Only covariation between pre-smoking hedonic change and being in the company of others (not smoking) was moderated at the person-level.

Being with others when smoking tends to increase hedonic elevation from baseline, but this effect is attenuated for people high in BAS sensitivity (as indexed by reward responsiveness). The direct effect of BAS reward responsiveness remained significant in this model; taken together with the lack of other interaction effects, this suggests that identified moderating effects are not mediated by situation. Individual differences in mood regulation are unlikely to arise from individual differences in context selection alone.

6.3.3 Individual variability in fit to the three models

Hedonic model-fit

People high in BAS sensitivity (indexed by reward responsiveness) were less likely to experience a pattern of hedonic change consistent with positive incentive effects (incentive sensitisation and appetitive incentive functions). This moderating effect is consistent with modelling of episodic mood changes, suggesting that pre-smoking hedonic elevation is attenuated in more reward-reactive individuals. That BAS sensitivity had similar moderating effects on fit to models predicting different pre- to post-smoking outcomes (no change or positive change) reinforces the notion that pre-smoking change is the operative element in smoking-related affective processes.

Reduced hedonic model-fit for incentive-based accounts was also evident in individuals with greater emotional stability, higher levels of negative baseline craving, and lower levels of positive baseline craving. Additionally, incentive-sensitisation model-fit was reduced in more extraverted individuals. In terms of moderation by Big Five trait dimensions, smokers high in neuroticism have a stronger tendency to experience positive-incentive hedonic responses and introverted smokers are specifically more likely to experience hedonic responses fitting the incentive-sensitisation model. The finding for extraversion is consonant

with episodic modelling and the Eysenckian notion of personality-associated hedonic regulation (Eysenck, 1967) discussed previously. The observed moderating effects of neuroticism warrant further discussion.

Individuals high in neuroticism have been found to be less responsive to nicotine in terms of subjective mood and biological correlates (even after controlling for habitual nicotine intake; Gilbert *et al.*, 1994), and it might be expected that lower affective reactivity to the direct effects of nicotine when smoking would condition more modest mood responses to pre-smoking processes following the development of incentive motivations. Implicit in such an expectation, however, is the notion that initial direct effects of smoking may transfer associatively to cues/anticipation with similar magnitudes of effect (further to valence and specificity of effect). Whilst there is evidence that a variety of once-neutral stimuli can be conditioned to cue changes in smoking expectation, craving, and mood, there is presently little evidence to suggest that elicited effects are equivalent in size to any pre-habituation effects of smoking (Lazev *et al.*, 1999; Bushnell *et al.*, 2000; Mogg *et al.*, 2003). More generally, conditioned responses have little resemblance to initial unconditional responses (Corr, 2004). Given this, the observed model-fit moderation by neuroticism probably reflects consequences of generally experiencing lower levels of happiness (emotional stability correlated with UMACL hedonic tone; .48). Smoking-related incentive cues may have a positive hedonic value (or 'attractiveness'; Robinson & Berridge, 1993) that is more salient to individuals with a relatively depressed hedonic baseline, such that they report larger incentive effects (Lang, Davis, & Ohman, 2000). The non-emergence of emotional stability as a moderator of change in episodic modelling might indicate that emotionally unstable individuals are more variable in their motivations/mood changes from episode to episode. These individuals may, however, show particularly strong hedonic reactivity in any episodes that *are* incentive-motivated, such that their mean happiness scores at baseline and pre-smoking tend to

demonstrate good fit to incentive functions (again, this is consistent with their profile of high reactivity to both BIS and BAS related stimuli).

Finally, the nature of the relationship between incentive model-fit and baseline levels of craving has some interesting implications. The two factors of the QSU are distinct, and are designed to tap different motivations to smoke (Tiffany & Drobes, 1991): a desire to smoke with anticipation of pleasurable effects (positive craving), and an urgent need to smoke to alleviate discomfort (negative craving). The former factor might be expected to reflect incentive-related smoking experiences, and the latter to reflect withdrawal-related smoking experiences. The present findings support such hypotheses; positive and negative craving at baseline predict individual fit to incentive models of mood-smoking in expected directions. However, these relationships were only evident when shared variance of the two factors (reflecting general desire to smoke) was partialled out of the analyses. Only residual variability (reflecting valence of motivation) was related to change-functions of approach mood-smoking, and this is consistent with the independence of desire changes and hedonic/energetic changes established in Chapter 5. Episodic craving was measured using the item that was found to be most indicative of overall QSU score (total baseline desire), but given the present findings - and other research demonstrating weak relationship between general craving measures and positive affective-components of motivation (Mogg *et al.*, 2003) – it is unsurprising that this singular measure was insensitive to captured incentive processes. General measures of desire to smoke are likely to be biased in sensitivity towards negative mood (e.g., Payne *et al.*, 1991) – consistent with conceptualisation of craving as an interruption of habitual motivational processes elicited by drug unavailability/obstacles to use (Tiffany, 1990) - and this might account for episodic covariation with anxiety and anger identified in the previous chapter. Examination of desire during abstinence supported this notion (see Chapter 9).

Energetic model-fit

People high in neuroticism were more likely to experience a pattern of arousal-change that fits models with positive incentive effects (incentive sensitisation – both inverted-U and step functions – and appetitive incentive). Fit to these models was greater for those low in emotional stability irrespective of the direction (or absence) of pre- to post-smoking changes. The implication is that the key component of smoking-related arousal change is from baseline to pre-smoking, and that this change is more pronounced for the relatively emotionally-unstable. This finding is consistent with indication from episodic modelling that pre-smoking elevation of alertness is greater in individuals with more neurotic tendencies. Taken with similar moderating findings for hedonic model-fit, there is a general suggestion that emotional instability pre-disposes greater reactivity to the identified smoking-related affective processes –mood-regulatory functions of smoking may be less effective, and perhaps less motivating, in more emotionally stable individuals.

It can further be inferred that – in spite of difficulty demarcating pre- to post-smoking energetic change tendencies – emotional stability may be a trait particularly associated with depressed arousal following smoking. Only emotional stability was related to inverted-U incentive-sensitisation fit. Age and heaviest smoking rate moderated model-fit in similar ways to emotional stability, but neither was associated with the inverted-U model of energetic arousal – the model indicated to be the best-fitting (in terms of deviance statistics) in the previous chapter.

The neuroticism-independent moderating effects of age and heaviest rate of smoking indicated that positive incentive models (step-function incentive sensitisation and appetitive incentive only) were a better fit to energetic responses of younger smokers and those with a history of lower-frequency smoking. Elicitation of energetic arousal associated with smoking-expectancy may diminish with age

and after heavy exposure to smoking. Perhaps these relationships tap variance associated with the effects of chronic smoking: a trend of tolerance to anticipatory arousal after prolonged or intense smoking exposure. Though, if this interpretation is correct, it might be expected that other measures of dependence and smoker history (age when first smoked, stability of smoking) would emerge as moderators. Moreover, such an interpretation would seem to contradict the basic tenet of sensitisation to incentive effects. However, Berridge and Robinson (2003) describe the additional influence of 'cognitive incentives' (cognitive representations of act-outcome; Dickinson & Balleine, 2002); these reasoned expectations might temper mechanisms involving basic associative/affective/motivational interactions (Dayan & Balleine, 2002). It follows that awareness of smoking effects - or lack thereof - might attenuate any conditioned incentive salience effects. Awareness could perhaps develop following periods of heavy smoking, or be particularly likely to develop in emotionally stable individuals - who may be more rational in their appraisal of smoking effects (e.g., Bartz & Olson, 2002).

6.3.4 Moderation of craving and its relation to mood and context

Figure 6.3 shows moderators of episodic craving covariation. Discussion in this section pertains to this model.

Figure 6.3

Model of episodic craving covariation: extended to consider moderation

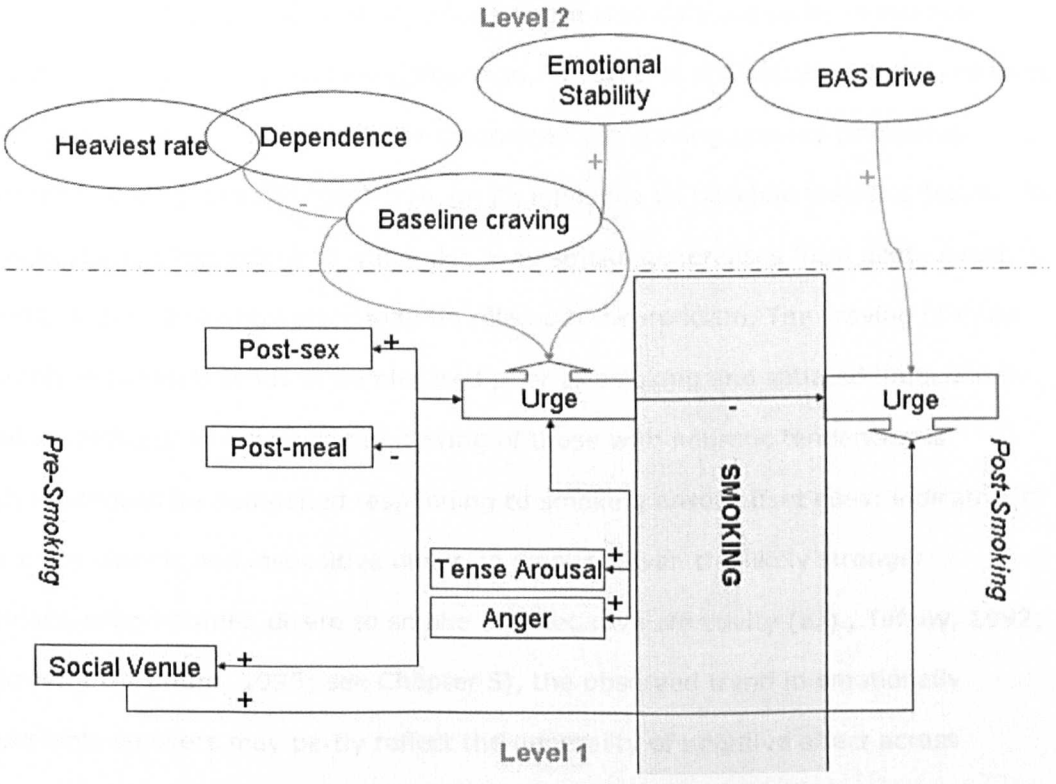


Figure 6.3 represents episodic urge-change covariation at Level 1 of the model and stable moderators at Level 2. At level 1, variables shown to the left of the smoking event depict pre-smoking slopes between urge changes and contextual variables. For example, smoking-related increases in craving were enhanced after sex, and this is depicted by the positive connection between urge and the post-sex state. As in previous figures, the direction of moderating relationships is shown by the symbols adjacent to connections from level 2 to level 1 variables. Pre-smoking urge-change was directly moderated by baseline urge score: urge increases are smaller/less reactive for those with greater generalised craving. Pre-smoking urge was also indirectly moderated (via baseline urge) by emotional stability and shared variance reflecting heavy dependent smoking. Individuals low in emotional stability and those with a history of heavier smoking behaviour experience more generalised craving; consequently, their urge state is less responsive (relatively attenuated increase) to imminent smoking. Post-smoking urge-change was directly moderated by BAS Drive: urge satiation is reduced for those with greater BAS impetus. Urge covariation with other level-1 variables (such as tense arousal and being in a social venue) was not moderated at level 2.

Although there is likely to be important systematic individual variability in craving experiences (Verheul, Brink, & Geerlings, 1999), and exploration of such variability has been encouraged (Cox *et al.*, 2001), there is to date a paucity of studies relating to craving moderation (Zilberman, Tavares, & el-Guebaly, 2003). Analyses suggested that emotional stability moderated the craving process (including smoking-contiguous changes) through its influence on baseline levels of desire. This suggests that the extent to which desire to smoke generalises from acute event-related shifts to typical state may be related to neuroticism. The craving of more stable individuals tends to be elevated prior to smoking and satiated immediately after smoking. In contrast, the craving of those with neurotic tendencies is characterised by dampened responding to smoking onset/offset cues: indicative of a more chronic and insensitive desire to smoke. Given the likely stronger relationship between desire to smoke and negative affectivity (e.g., Tiffany, 1992; Sayette & Hufford, 1995; see Chapter 5), the observed trend in emotionally unstable smokers may partly reflect the generality of negative affect across behaviour that is a feature of neuroticism (Gomez, Cooper, & Gomez, 2000). It appears that neuroticism disposes smoking-distal engagement of craving (potentially related to BIS reactivity) further to arousal engagement by (imminent) smoking (BAS reactivity). It can be seen that these influences are somewhat dysfunctional: craving levels are persistently high and smoking is found to be particularly arousing against a background of low energetic arousal.

In this chapter's analyses of individual differences in mood-smoking relationships (and associated level 1 variability), outcomes have proven insensitive to measures of dependence. Affective-motivational processes at the episodic level of analysis appear to be independent of analysed indicators of dependence severity. Desire, however, did show some relation to variance reflecting current dependence and history of heavy smoking. Again, moderating effects were mediated by baseline craving, suggesting that smokers with more dependence-experience may perceive

a persistent desire to smoke that is less reactive to pre-smoking cognitions. Interestingly, dependence severity was not related to experiences of satiation; despite generally elevated levels of craving, and insensitivity to pre-smoking processes, more dependent individuals experience similar desire-relief from smoking to that experienced by their less dependent counterparts (though perhaps their relief is qualitatively different, in terms of cognition underlying "desire").

Satiation was moderated by BAS (as indexed by the drive subscale), in a relationship specific to the pre- to post-smoking component of desire change. Individuals with a stronger approach drive are less responsive to smoking consummation in terms of their craving. This likely reflects theorised persistent-approach in the drive construct (Acton, 2003; Carver & White, 1994; Heponiemi *et al.*, 2004). Such BAS drive-related experiences could be associated with binge patterns of behaviour (Kane *et al.*, 2004) or sensitising effects for other behaviours that might normally be inhibited (Paine *et al.*, 2003).

6.4 Next chapter

Chapter 7 compares findings relating to episodic smoking motivation (chapter 5 and the present chapter) with parallel hierarchical modelling of natural consumption behaviour. To this end, investigatory approaches introduced for smoking thusfar were applied to eating behaviour. Subsequently derived models could then be compared with those considered for smoking. Chapter 7 further combined smoking and natural consumption data-sets to facilitate direct comparisons of mood changes, cravings, and contexts associated with smoking versus eating behaviours.

Chapter 7. Eating as a comparative consumption behaviour

Preceding chapters (5 and 6) identified an episodic model of smoking motivation (changes in mood and desire) and extended this to consider moderating influences at the level of the individual. The present chapter identified a parallel hierarchical model of episodic eating motivation – so as to provide a point of comparison. Smoking has been conceptualised in the broader context of reward behaviour and natural appetitive motivation (Berridge & Robinson, 1998; Di Chiara, 1995; Koob & Le Moal, 1997), and the introduction to this thesis specifically considered parallels between smoking and food consumption (e.g., Wise, 1997; Grunberg & Baum, 1985). Furthermore, a research plan was established within which food consumption would be sampled in parallel to sampling of smoking behaviour; the present chapter is the first to consider this data as it reflects on findings for smoking. It is important to gain an understanding of whether smoking-related findings generalise across consumption behaviours or are more particular to smoking (and possibly other maladaptive consumption behaviours; e.g., Kaye, 1999).

What might be the likely outcome of present analyses, given what has been found for smoking behaviour? Little research has attempted to investigate multiple appetitive behaviours using equivalent methods, or to directly compare smoking with natural consumption behaviours such as eating – despite advocacy of such an approach (Grunberg & Cousino Klein, 1998; Gilbert, 1995). However, there is some evidence to suggest that smoking and eating should be similar in rewarding effects (Jaffe, 1990; Warburton, 1990) – and, by extension, motivation. For example, Warburton (1988) found that the positive mood effects of smoking were rated as being equal in magnitude to those of palatable food. There is also evidence that

food reward may operate by the same reinforcement model as smoking: Spring and colleagues (2003) found that palatable foods gained increased reward value (greater allocated obtainment effort, relative to monetary incentives, and independently of increases in hunger or perceived palatability) for nicotine-deprived smokers. This is consistent with the theoretical notion that eating and smoking may be substitutable rewards within a common mechanism (Niaura *et al.*, 1992; Ogden, 1994). Preceding chapters support an incentive-sensitisation model of smoking motivation, and this model is highly compatible with the notion of eating to compensate for absent smoking reward (Robinson & Berridge (2001). The theory suggests that the motivational significance of eating may become cross-sensitised when smoking is blocked – accessible rewards gain incentive value.

The implications of this for the present chapter might then be that eating-related mood effects should be similar to those identified for smoking (incentive-based boosts in hedonic tone and energetic arousal) – since both behaviours are appetitive rewards with potential for motivational transference. However, it is also conceivable that food may only acquire the motivational effects of smoking for deprived smokers (Epping-Jordan *et al.*, 1998; i.e., cross-sensitisation changes the nature of eating effects to match smoking effects, rather than simply enhancing effects that are naturally the same for both behaviours). Participants in the present eating study were non-smokers, and it may be that natural eating motivation differs from motivation that develops for smoking. Any differences between smoking and eating models in the present study may thus be informative about how a common reward system can be set askew by maladaptive substance-use (Wolf, 1998). Nonetheless, some similarity in mood effects was expected based upon the classification of both smoking and eating as appetitive behaviours (Carroll *et al.*, 1991). It was considered that snacking episodes and episodes involving consumption of sweet/fatty foods might resemble smoking episodes most closely (short duration, potentially more impulsive/less overtly functional) - and thus be

more likely to involve hedonic motivation. All episodes were coded in terms of food type(s) and episode type (snack/meal) to capture this variability.

The nature of motivationally relevant covariation and moderation was difficult to predict without foreknowledge of mood-eating relationships – since episodic mood changes were the central outcomes examined in relation to momentary context and personality. However, it has been shown that cue-induced conditioning can be induced using similar methods for both eating and smoking (Schroeder *et al.*, 2001). This suggests that contextual dependencies could be similar; although situational restrictions – being able to eat in settings where smoking is forbidden, for example – may produce different patterns of conditioning. In terms of craving, it has been suggested that urges for food and drug use are similar phenomena (Wise, 1997; Gibson and Desmond, 1999); though, again, specific cues may differ between behaviours – and eating urges may activate a wider range of possible responses (in terms of food choice).

Though comparative interpretation of moderating relationships may be difficult unless smoking and eating are similar in variability at level 1, analyses in the present chapter could be informative about whether the role of BAS uncovered for smoking holds for natural reward behaviours. One interpretation considered in the previous chapter is that smoking may be particularly rewarding for low-BAS individuals (contrary to original hypotheses) because they are less responsive to natural rewards. If this explanation is correct, BAS moderation of the kind evinced in smoking may not be evident for eating. Another reason moderating relationships might be expected to differ between behaviours is that measured personality in non-smokers may be incomparable with the same measures in smokers due to a fundamental disparity between these groups: however, available evidence suggests that there is no such disparity that would invalidate (continuum-based) trait comparisons (Kassel *et al.*, 2003).

Differences - between smokers and non-smokers and between smoking and eating episodes – did however form the focus of the final set of analyses in the present chapter, wherein eating and smoking data-sets were combined. In research comparing smokers and non-smokers, personality differences have not been shown consistently (Smith, 1970; Arai *et al.*, 1997; Shadel *et al.*, 2000). Based on reviews to date (Gilbert, 1995; Acton, 2003) it was predicted that smokers would tend to be higher in BAS-related traits and psychoticism (low conscientiousness and/or agreeableness in the big five). Direct comparative modelling of eating and smoking episodes would partly serve to clarify and validate any apparent contrasts between the (separately-specified) smoking and eating models. It would also highlight contexts within which smoking (versus natural consumption) is more likely to occur – contexts that may be important in interventions, since they are associated with smoking more than other appetitive behaviour.

In summary, central aims of this chapter were:

1. To identify episodic variability in eating behaviour such that results could be compared with findings from Chapter 5. To this end, specific goals were:
    a. Examine the three reward models in relation to mood-eating behaviour. Does the Incentive-Sensitisation model describe mood in relation to eating episodes as it does for smoking?
    b. Assess contextual contingencies of identified components of mood change. For example, is eating-related mood sensitive to the presence of others, as in smoking?
    c. Characterise urge change across stages and its relationship with mood and contextual variability. Does desire to eat mirror desire to smoke in its sensitivity to consumption and contemporaneous conditions?

2. To assess potential moderation of identified episodic variability in order to gauge consistency of moderation across consumption behaviours. For example, do those with low-BAS sensitivity show greater appetitive mood responses before eating?
3. To directly compare consumption behaviours by modelling combined episodic data as a function of behaviour-type, and exploring regression models of trait variability that can predict smoker versus non-smoker status. How do the subjective experiences and situations associated with smoking episodes differ from those in a natural consumption episode? Also, how do smokers differ from non-smokers in terms of their personality?

7.1 Data Analyses

7.1.1 Episodic variability

7.1.1.1 Comparing the three models

As in analysis of smoking data (chapter 5), a repeated measures MANOVA was conducted to examine general mood change across states. Only mood dimensions demonstrating a significant main effect of change (across the three testing intervals) in the MANOVA were submitted to further analyses.

7.1.1.2 Mood changes and episodic context

Multilevel modelling of episodic data replicated analyses reported in Chapter 5. For each recorded eating event, baseline scores were deducted from pre-eating item scores, and pre-eating mood scores were deducted from corresponding post-eating mood scores. These change scores were first examined in unconditional models and as a function of contextual variability.

Variables relating to context were examined across five categories: temporal, company, location, activity, and consumption. Temporal variables were *episode length* (in minutes), *minutes since ate* and *serial position* (nth episode of the day). Company variables were *others not eating* (coded as 0 = alone at time of episode, 1 = with others, who were not eating) and *others eating* (0 = no-one else eating at time of episode, 1 = others eating). Location variables were *home*, *social venue*, and *outdoors*; all three were binary variables (coded as 0 = episode occurred elsewhere, 1 = episode occurred in this place-type). Activity indicator variables were *resting*, *working*, *active-engagement*, *drinking alcohol*, *drinking tea/coffee*, and *post-sex*; all were binary variables reflecting non-occurrence/occurrence in this state of activity. Consumption variables were *snack/meal* (0 = snack, 1 = meal), *amount consumed* (4-point Likert scale), and *food group*. This latter variable was represented by six binary variables reflecting the absence/presence of different food types in each consumption episode: (1) fats, oils, and sugars; (2) grains; (3) fruits; (4) milk products; (5) vegetables; and (6) meat and protein (poultry, fish, dry beans, eggs, and nuts). This coding scheme for food and nutrients is widely applied and based on extensive dietary research (Welsh, Davis, & Shaw, 1993; USDA, 2000). The scheme shows validity in application; for example coding of food intake across the six groups is predictive of mortality (Kant, Graubard, & Schatzkin, 2004).

7.1.1.3 Craving and its relation to mood and context

This stage of analysis pertained to desire to eat and its covariation with mood and context. The programme of analyses applied emulated analyses of episodic desire to smoke (chapter 5).

7.1.2 Moderating role of individual variability

At this stage of analysis, episodic variability was examined as a function of person-level measures (Table 7.1 shows the measures used). Preceding models were extended at level 2 to identify moderators of mood change scores, mood-context slopes, desire change scores, and desire-context slopes. Only significant change scores and slopes were examined as a function of person-level measures in these models. Subsequently, only measures found to moderate change scores directly were examined as potential moderators of relevant slopes. In all models at this stage of analysis, correlated moderators were checked for independence.

Table 7.1

Trait measures examined as potential moderators

BIS/BAS	Big Five	TFEQ	Baseline Craving	Readiness to Change	Eater History	Demographics
BASDRV	S	Emotional eating	QEU1	Perceived addiction	Lowest weight	Age
BASRR	A	Dietary restraint	QEU2	Desire to change	Highest weight	Gender
BASFUN	C			Confidence in ability	Ideal weight	BMI
BIS	ES				Diet attempts	
	I				Social pressure	

S = Surgency, A = Agreeableness, C = Conscientiousness, ES = Emotional Stability, I = Intelligence.
BASDRV = Behavioural Approach System Drive, BASRR = BAS Reward Responsiveness, BASFUN = BAS Fun-Seeking, BIS = Behavioural Inhibition System. BMI = Body Mass Index
TFEQ = Three Factor Eating Questionnaire, QEU1 = positive craving (factor 1) score, QEU2 = negative craving (factor 2) score.

Table 7.1 presents the level 2 variables that were examined in relation to variability at level 1 of eating models. Variables are organised in seven categories (columns). The most important of these for the present research were the BIS/BAS markers in the first column, followed by the Big Five trait dimensions in the second column. Other variables were largely included for descriptive purposes - and to provide equivalence for smoking-specific variables examined at level 2 of smoker models.

7.1.3 Direct comparisons

Smoking and eating episodes

In these analyses, episodic data-sets from the eating diary and initial smoking diary were combined. The intervention-diary data was not used, as its inclusion would imbalance the number of participants in each group (smokers versus non-smokers) for planned between-persons analyses (logistic regression). Firstly, mood and desire change scores at level 1 were examined as a function of diary-type at level 2. Diary type was a binary variable coded as 0 = eating diary, 1 = smoking diary. In this way, these analyses identified significant differences in the magnitude of mood and desire changes related to smoking versus eating events. Further analyses examined appropriate contextual variables as level-1 outcomes, with diary type at level 2. In this way, these analyses identified significant differences in the situational correlates of smoking versus eating events.

Contextual measures were designed to have some degree of equivalence across diaries. Variables in location and activity categories were the same in both studies. Temporal and company variability was assessed with parallel measures, such that they require only a descriptive re-definition. Temporal variables were *episode length* (in minutes), *minutes since consumed* and *serial position* (nth episode of the day). Company variables were *others not consuming* (coded as 0 = alone at time of episode, 1 = with others, who were not smoking/eating as appropriate) and *others consuming* (0 = no-one else consuming at time of episode, 1 = others smoking/eating). Consumption variables were judged not to possess the requisite cross-diary compatibility for these analyses.

Analyses of binary outcomes applied Hierarchical Generalised Linear Modelling (HGLM) to account for statistical issues with non-linear dependent variables (see Raudenbush *et al.*, 2000). Predicted values are thus transformed using a logit-link

function to lie between the constrained values of 0 and 1, and reported coefficients represent the log-odds of outcome = 1.

Personality and smoker status

In these analyses, person-level data-sets from the eating study and initial smoking study were amalgamated. A binary variable was dummy-coded to represent the sample from which each individual case was derived. Individuals who participated in the initial smoking study were assigned the value of 0, and individuals who participated in the eating study were assigned the value of 1. As all subjects participating in the latter study were non-smokers, the dichotomous variable representing sampled behaviour-type also represents (non-)smoker status where 0 = smoker, and 1 = non-smoker. There were 42 smokers and 42 non-smokers in the combined data set.

Regression analyses were conducted to predict smoker status as a function of variability in personality – specifically, BIS-BAS and Big Five dimensionality. As the linear probability model is heteroskedastic, and may predict probabilities beyond the (0, 1) range, the logistic regression model was used to estimate the factors that influence smoker status. Exploratory logistic regression analyses were carried out using a forward (likelihood ratio) selection method, with subscales of the BIS-BAS and Big Five entered in two separate blocks/models.

7.2 Results

7.2.1 Episodic variability

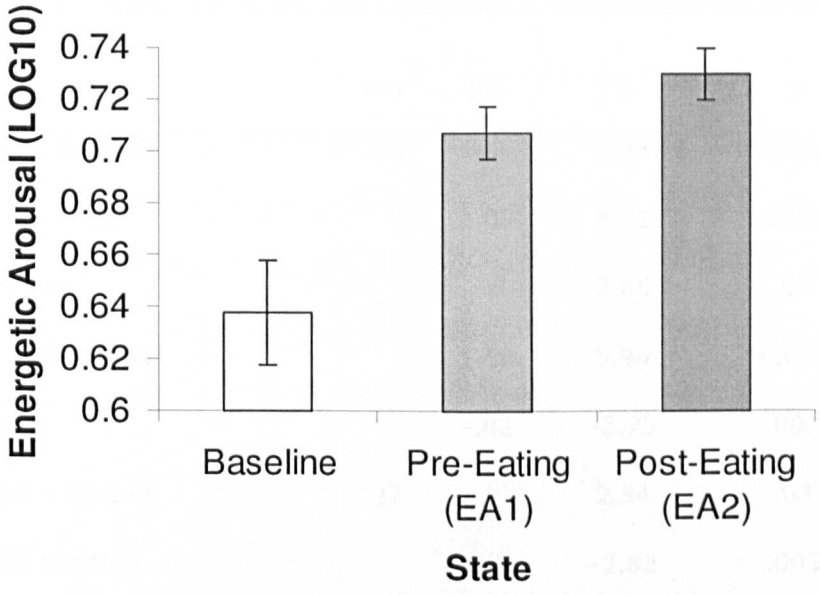
7.2.1.1 Comparing the three models (eating only)

The MANOVA revealed a significant main effect of energetic arousal [$F(2,82)= 11.50$, $p < .001$), no main effects of other mood dimensions were observed. Figure

7.1 indicates that energetic arousal increases in the anticipatory pre-consumption state, and increases further following consumption. Such a pattern fits the appetitive-incentive model of associative mood mechanisms, with positive arousal response to cued intention to eat (pre-consumption state), and additional elevation of arousal from the direct effects of ingestion (post-consumption state). Simple main effects analyses were carried out on the mean state differences in energetic arousal, revealing that pre-consumption energetic arousal (EA-pre) was significantly greater than energetic arousal at baseline (EA base)[$F(1,41)= 9.20$, $p = .005$], and post-consumption energetic arousal (EA-post) was significantly greater than EA-Pre [$F(1,41)= 3.93$, $p = .05$]. These findings support an appetitive-incentive account of motivation, with a significant increase in positive mood valence at the cued pre-consumption state, and an additional significant increase at the post-consumption state. Energetic arousal of mood associated with consumption cues was, on average, more positive than at baseline, as was energetic arousal of mood associated with actual consumption. Subsequent analyses focused on the identified components of energetic mood change.

Figure 7.1

Mean energetic arousal at baseline, pre-eating, and post-eating states



Note. Error bars depict standard deviations.

7.2.1.2 Mood changes and episodic context

Table 7.2 shows all significant mood changes (γ_{00}) and relevant covariation with episodic context (γ_{01}). Subsequent sub-sections detail the results, grouped by mood change: beginning with arousal change from baseline to pre-consumption and proceeding to arousal change from pre- to post-consumption. Modelling in this section parallels analyses carried out in Chapter 5. The reader is referred to Table 7.2 for coefficients and associated values pertaining to slopes and intercepts in this section.

Table 7.2

Episodic relationships between significant mood changes and contextual variables

	γ_{00}	γ_{10}	*t*	*p*
EA-pre – EA-base	.60		2.83	.008
Social venue		1.09	4.01	<.001
Outdoors		.75	2.65	.01
Drinking alcohol		1.68	5.94	<.001
Resting		-.82	-3.75	.001
EA-post – EA-pre	.27		2.34	.03
Serial position		-.15	-2.82	.005
Others eating		-.65	-6.02	<.001
Others, not eating		-.47	-2.40	.01
Drinking alcohol*		.48	3.18	.004

EA-pre – EA-base = Change in energetic arousal from baseline to pre-consumption state. *EA-post – EA-pre* = Change in energetic arousal from pre- to post-consumption state. *Partial result from modelling with EA-pre – EA-base as γ_{20}

Note. Mean unstandardised coefficients are in the columns labelled γ_{00} and γ_{10}.

Baseline to pre-consumption energetic covariation

As suggested by previous aggregate-based analyses, the mean EA-pre - EA-base slope was positive and significantly different from 0 (γ_{00}= .60, *t*= 2.83, *p* = .008). Arousal changes from a general state to a state between preparation-to-eat and actual consumption tended to be positive, with elevated alertness in pre-consumption responses as compared to baseline.

Further analyses examined contextual relationships with this change. In terms of location, elevation of arousal was greater in episodes that occurred in social venues

and when outdoors. In terms of activity, arousal elevation was greater in episodes that occurred whilst drinking alcohol, and was attenuated in episodes that occurred whilst resting. No other contextual variables were uniquely predictive of EA-pre – EA-base.

Pre- to post-consumption energetic covariation

Mood change from pre- to post-consumption state tended to be positive, with increased energetic arousal reported after eating – this supported aggregate-based analyses in the previous section. When the influence of EA-pre - EA-base was examined, it was found that elevation of arousal from pre- to post-eating was attenuated in episodes where elevation from baseline to pre-eating had been greater.

Further analyses examined contextual relationships with this change. Elevation of arousal was attenuated when an episode occurred whilst in company; whether others present were eating or not. In terms of temporal variability, elevation of arousal was attenuated in episodes that occurred later in the day. In terms of activity, elevation of arousal was attenuated in episodes that occurred whilst drinking alcohol (γ_{10}= -.35, t= -2.86, p = .008). However this relationship interacted with prior energetic change: when EA-pre – EA-base was entered into this model, the relationship between drinking alcohol and EA-post – EA-pre remained significantly different from 0, but became positive (this is the relationship presented in Table 7.2). When variance associated with pre-eating energetic change is partialled out of covariation between post-eating change and alcohol consumption, drinking appears to enhance elevated alertness after eating, No other contextual variables were uniquely predictive of EA-pre – EA-base.

7.2.1.3 Craving and its relation to mood and context

This stage of analysis characterised acute episodic changes in desire to eat and their relationship with mood changes and contextual variability at the same level. Modelling is as in Chapter 5.

Changes in desire to eat

A significant main effect was found [$F(2,82)= 62.23$, $p < .001$]. Pre-eating desire (D-pre) was significantly greater than desire at baseline (D-base) [$F(1,41)= 38.94$, $p < .001$] and post-eating desire (D-post) was significantly lower than D-pre [$F(1,41)= 490.62$, $p < .001$] – see Figure 5.2. Subsequent multilevel analyses modelled desire-change scores unconditionally and as a function of other level-1 variables. Desire change from baseline to pre-consumption is examined first, followed by change from pre- to post-consumption. Table 7.3 shows significant desire-change coefficients (γ_{00}) and relevant covariation with episodic context (γ_{01}). These values are not restated in the main body of this section of results.

Table 7.3

Episodic relationships between significant urge changes and contextual variables

	γ_{00}	γ_{10}	*t*	*p*
D-pre – D-base	1.32		5.08	<.001
Meat, protein, fish, etc.		.75	5.54	<.001
Grains		.70	5.02	<.001
Vegetables		.64	6.36	<.001
D-post – D-pre	-2.84		-24.50	<.001
Others eating		-.50	2.23	.03

D-pre – D-base = Change in desire from baseline to pre-consumption state. *D-post – D-pre* = Change in desire from pre- to post-consumption state.

Note. Mean unstandardised coefficients are in the columns labelled γ00 and γ10.

Baseline to pre-consumption desire covariation

Desire to eat was elevated in pre-eating responses as compared with baseline. Succeeding analyses examined this change (D-pre – D-base) in relation to change scores for mood; no significant relationships emerged.

Further analyses examined contextual covariation with D-pre - D-base. Elevation of hunger was increased before consumption of three food-types: meat, protein, fish, dried beans and nuts; grains; and vegetables. No other contextual variables were uniquely predictive of D-pre – D-base. The covarying food-types may be more commonly selected in balanced meals; indeed urge elevation did show a positive relationship with meal (versus snack) events, but this slope did not remain significant when the specific food-types were entered into modelling. This shared variance bolsters the notion that the identified covariates are markers of meal

content – suggesting reactivity between urge to eat and preparation of substantial foods.

Pre- to Post-consumption desire covariation

The desire to eat decreased significantly following consumption. Succeeding analyses examined this change (D-post - D-pre) in relation to change scores for mood, but no significant relationships were found. When the influence of D-pre – D-base was examined, it was found that satiation was greater in episodes where pre-consumption urge had been greater (γ_{10} = -.79, t = -10.34, p < .001) relative to baseline.

Further analyses examined contextual covariation with D-post – D-pre. Satiation of hunger was reduced when eating in the company of others who were concurrently eating. No other contextual variables were uniquely predictive of D-post – D-pre.

7.2.2 Moderating role of individual variability

This stage of analyses extended previous models at level 2 to uncover moderating influences on episodic outcomes.

Baseline to pre-consumption energetic moderation

Energetic change (EA-pre - EA-base) was negatively related to trait surgency (γ_{01}= -.05, t= -2.6, p = .05). People with lower surgency scores were more likely to experience greater elevation of arousal compared to their more extraverted counterparts.

When baseline energetic arousal (EA; γ_{01}= -.23, t= -13.98, p = <.001) was entered concurrently with surgency at level 2 of this model, only EA remained significant. The effect of surgency on pre-smoking arousal change may be mediated

by its influence on baseline arousal. People high in surgency generally experience more energetic arousal (as captured at baseline), such that their alertness is less responsive to the onset of eating episodes.

As moderating effects of surgency were dependent on baseline energetic arousal, slopes pertaining to EA-pre - EA-base were not examined as a function of person-level variables (no direct moderators were identified).

Pre- to post-consumption energetic moderation

Energetic change (EA-post – EA-pre) was positively related to perceived addiction to snacking (RC Addiction; γ_{01}= -.05, t= -2.6, p = .05). People who report greater dependence on consumption behaviour were more likely to experience greater elevation of arousal compared to those who report low 'addiction'.

This relationship was not contingent on EA-pre – EA-base, and did not moderate any of the identified slopes for EA-post – EA-pre.

Baseline to pre-consumption desire moderation

Desire change (D-pre – D-base) was only related to baseline desire (QEU; γ_{01}= -1.06, t= -10.31, p = <.001). This implies that the effects of emotional stability and dependence history on pre-smoking desire change are mediated by their influence on baseline levels of craving. The hunger process appears to be independent of trait-variability as measured in the present research

Further analyses examined moderation of contextual covariation with D-pre - D-base. All slopes were moderated by baseline craving in the same direction: meat, protein, fish, dried beans and nuts (γ_{11}= -.58, t= -5.08, p < .001); grains (γ_{11}= -.46, t= -3.36, p = .002); and vegetables (γ_{11}= -.26, t= -3.30, p = .003).

Individuals with greater desire to eat at baseline experienced smaller pre-eating changes in desire, and this trend diminished identified slopes for food-types.

Pre- to post-consumption desire moderation

Desire change (D-post – D-pre) was positively related to gender (γ_{01}= .57, t= 2.91, p = .007). No other level 2 variables were found to moderate satiation. Males tend to experience less satiation of hunger from eating than females. When preceding desire change (D-pre – D-base) was entered at level 1 of this model, gender remained significant. This implies that the effect of gender on desire to eat is specific to assuagement following consumption.

Final analysis at this stage examined moderation of contextual covariation with D-post – D-pre. No significant relationship emerged in this analysis.

7.2.3 Direct comparisons

Table 7.4 shows episodic experiences that were significantly associated with smoking behaviour, relative to eating behaviour. All level 1 variables were examined as an outcome of event-type at level 2. As event-type was a binary variable (0, 1; where 1 = smoking), positive coefficients indicated that variables had higher values in smoking versus eating episodes. Coefficients and associated statistics are not restated in the main body of results.

Table 7.4

Experiences associated with smoking (versus natural consumption) episodes

	γ_{01}	*t*	*p*
Mood changes			
HT-pre – HT-base	.49	2.00	.05
EA-post – EA-pre	-.32	-2.22	-.03
Temporal variability			
Episode length	-9.14	-12.43	<.001
Time since previous episode	-88.29	-4.66	<.001
Activities			
Drinking alcohol	1.84	5.21	<.001
Resting	-.71	-4.55	<.001
Active tasks	2.81	5.87	<.001
Working	-.64	-3.17	<.001
Locations			
At home	-.90	-3.40	.001
Social venue	1.93	6.57	<.001

HT-pre – HT-base = Change in hedonic tone from baseline to pre-consumption state. *EA-post – EA-pre* = Change in energetic arousal from pre- to post-consumption state.

Note. Mean unstandardised coefficients are in the column labelled γ01

Changes in mood and desire to consume

Elevated pre-event happiness was greater for smoking events, and elevated alertness post-event was greater for eating events. No other mood changes were significantly different between behaviours (in terms of association). These analyses supported findings from separate modelling of eating- and smoking-related mood changes.

Event-related changes in desire were not significantly (quantitatively) different between behaviours.

Context of consumption

Eating episodes tended to last longer, and to be separated by longer inter-event periods, as compared with smoking episodes. In terms of odds ratios pertaining to event-concurrent activity state, smoke events (relative to eating events) were 6.3 times more likely to occur whilst drinking and 16.6 times more likely to occur whilst performing active tasks (such as driving); but they were 2 times less likely to occur whilst in a restful state, and 1.9 times less likely to occur whilst working/studying. In terms of relative odds pertaining to event location, smoke events were 6.9 times more likely to occur in social settings, and eating events were 2.5 times more likely to occur at home.

Personality and smoker status

Logistic regression results are presented in Table 7.5. Two models are presented; the dependent variable in each is smoker status. Each model includes different blocks of independent variables (scored continuously). Model 1 includes only the BIS/BAS subscales. The results from Model 1 indicate a bidirectional trend in BAS differences. The coefficient on the BAS fun-seeking variable is negative and has a Wald statistic equal to 10.09 [df=1], p = .001. People high in BAS fun-seeking are more likely to be smokers. The coefficient on the BAS drive variable is positive and has a Wald statistic equal to 4.08 [df=1], p = .04. People high in BAS drive are more likely to be non-smokers. No other subscales of BIS/BAS emerged as significant in this model. The overall model is significant at the .0001 level according to the Model chi-square statistic (40.9). The model predicts 64% of the responses correctly. The Cox & Snell R^2 statistic is .14.

In Model 2, scores on trait dimensions of the Big 5 were entered. According to the block chi-square statistic, Model 2 is superior to Model 1 in terms of overall model fit. The block chi-square statistic (11.32, df=1) was significant, p = .001. The percentage of correct predictions increased by 8.1% to 72.1%, and the Cox & Snell R^2 statistic increased by 56% to .25. The coefficient on conscientiousness is positive and has a Wald statistic equal to 9.69 [df=1], p = .002. People high in conscientiousness are more likely to be non-smokers.

From the two models/blocks, the trait variables that emerge as being significantly related to smoker status are BAS reward responsiveness and Conscientiousness. Conscientiousness is the most powerful predictor.

Table 7.5

Logistic regression results with dependent variable = Smoker status

	Model 1		*Model 2*	
Variable	Coefficient	Wald	Coefficient	Wald
Constant	2.02	1.55	-2.92	1.57
BAS Fun-Seeking	-.40*	10.09	-.28*	4.16
BAS Drive	.27*	4.08	.18	1.65
Conscientiousness			.13*	9.69
Model Chi-Square [df]	12.9[2]		24.2[3]	
Block Chi-Square [df]			11.32[1]	
% Correct Predictions	64.0		72.1	
Cox & Snell-R^2	.14		.25	

Note: The Wald statistics are distributed chi-square with 1 degree of freedom
* Indicates that the coefficient is statistically significant at, at least, the .05 level

7.3 Discussion

With regards to the principal aims of the present chapter:

1.

    a. At the episodic level, smoking behaviour and eating behaviour have distinct affective correlates – supporting different models of mood-

motivation. In contrast to smoking episodes, eating does not alter hedonic experience, and energetic elevation shows an Appetitive-Incentive (versus Incentive-Sensitisation) pattern.

b. Where comparable, the situational contingencies of consumption-related mood changes show some commonality between behaviours. For example, energetic arousal is dampened when resting in both smoking and eating episodes.

c. Desire processes demonstrate similarity across consumption behaviours, although desire to eat showed lower dependence on contextual and affective variability than desire to smoke.

2. Moderating relationships between behaviours were discrete, with more systematic individual variability in smoking versus eating episodes.
3. Analyses of combined data confirmed that, relative to eating events, smoking events were associated with different mood changes and situations. BAS fun-seeking and conscientiousness emerged as predictors of smoker status.

As a reflection of the primary purpose of this chapter, subsequent sections discuss findings for eating behaviour in relation to previous findings for smoking.

7.3.1 Three models of consumption

In terms of the models of reinforcement under investigation, food consumption is associated with an appetitive-incentive pattern of mood change (e.g., Wise & Bozarth, 1987). Positive mood (specifically, energetic arousal) increases in the cued anticipatory state before eating, and is additionally elevated in the state immediately post-consumption. This overall trend is clearly different from that observed in smoking behaviour: elevation of both energetic and hedonic mood responses, but only in relation to the pre-smoking incentive state. It has been

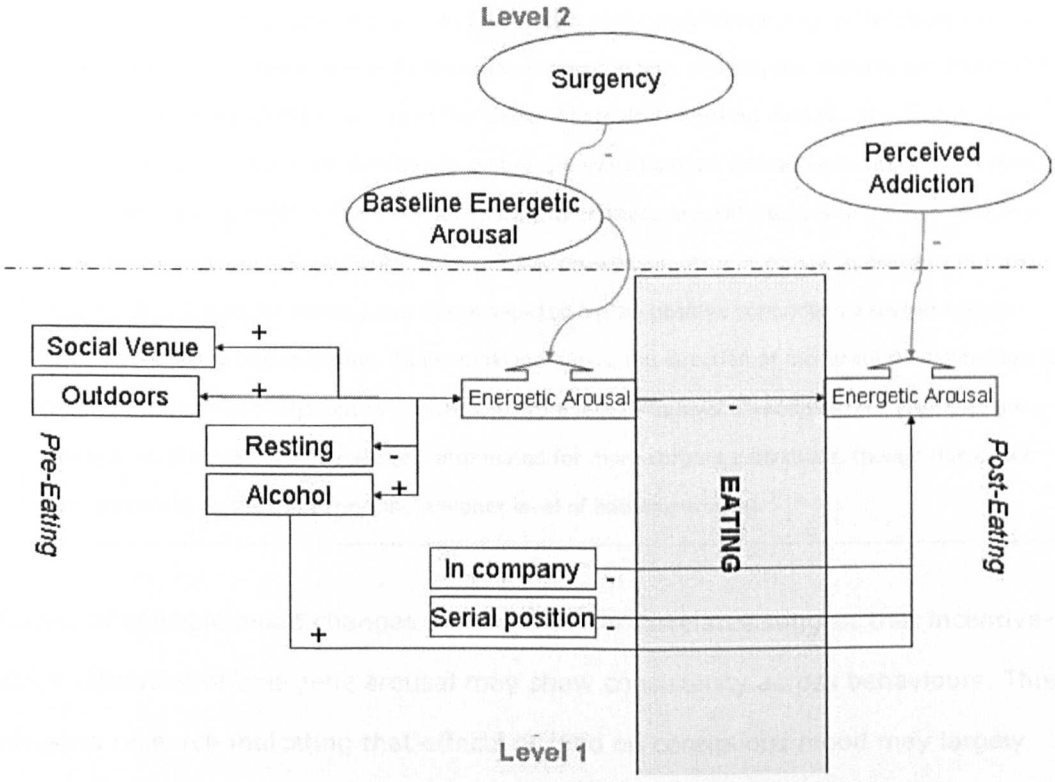
theorised that natural rewards have positive effects through both priming and consumption stages but that other substances may fractionate reward such that incentive effects become relatively intensified in a way that encourages compulsive behaviour (Kelley & Berridge, 2002; Hyman & Malenka, 2001). The present findings offer some support for this notion, demarcating smoking and food consumption in terms of associated mood changes. It is important to stress that findings for food consumption were obtained with a sample of individuals who are within a healthy BMI range and report normal attitudes towards eating. Findings for individuals with compulsive - or otherwise disordered - eating behaviours might resemble smoking-related trends more closely (Di Chiara, 2002; Drobes *et al.*, 2001).

7.3.2 Consumption, covariation, and moderation

Figure 7.2 shows two models: one of eating-related mood-change (with relevant covariates and moderators), and the other a reproduction of the equivalent model for smoking (developed over preceding chapters). These models are presented together in this figure for convenience of comparison. Discussion in this section pertains to the former model, but particularly considers its similarity (or otherwise) to the latter.

Figure 7.2

Episodic model of mood in relation to food consumption



Episodic model of mood in relation to smoking

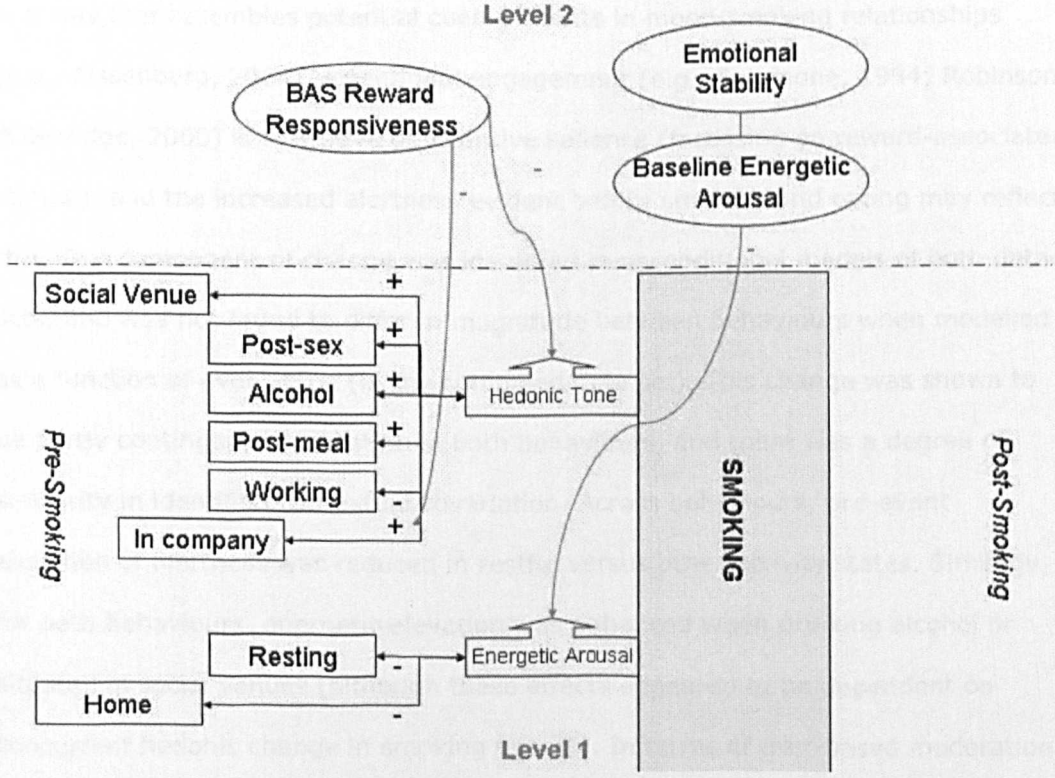


Figure 7.2 presents two episodic models, both representing mood change-covariation at Level 1 and stable moderators at Level 2. The first model pertains to eating episodes (drawing on data in the present chapter); the second is a repeat presentation of the parallel smoking model (from the previous chapter) – shown here to facilitate comparison across consumption behaviours. The novel (food consumption) model conforms to the format of previous smoking models. Box-arrows show increased energetic arousal before eating (left of the event) and an additional increase in energetic arousal after eating (right of the event). Links between these arousal changes and other variables show observed contextual reactivity. For example, pre-consumption increases in energetic arousal were enhanced in social venues, and this is depicted by the positive connection between hedonic tone and the social venue setting. As in smoking figures, the direction of moderating relationships is shown by the symbols adjacent to connections from level 2 to level 1 variables. For example, pre-eating arousal elevation was relatively attenuated for more surgent individuals, though this effect was dependent on their experiencing a higher level of baseline arousal.

Models of episodic mood changes and contiguous correlates suggest that incentive-stage activation of energetic arousal may show consistency across behaviours. This supports research indicating that effects of food on contiguous mood may largely derive from anticipatory associative cues (Bulik *et al.*, 1996; Rozin & Fallon, 1987) in a way that resembles potential cueing effects in mood-smoking relationships (e.g., Eissenberg, 2004). Attentional engagement (e.g., Salomone, 1994; Robinson & Berridge, 2000) is indicative of incentive salience (focussing on reward-associated stimuli), and the increased alertness evident before smoking and eating may reflect this. This component of change was identified in unconditional models of both data-sets, and was not found to differ in magnitude between behaviours when modelled as a function of event-type (in the combined data set). This change was shown to be partly contingent on situation in both behaviours, and there was a degree of similarity in identified contextual covariation. Across behaviours, pre-event elevation of alertness was reduced in restful versus other activity states. Similarly, for both behaviours, energetic elevation was enhanced when drinking alcohol or situated in social venues (although these effects appeared to be dependent on concurrent hedonic change in smoking events). In terms of trait-based moderation

of this change, the behaviours differed somewhat: pre-eating arousal was related to surgency whereas pre-smoking arousal was related to emotional stability. However, for both behaviours, moderation was dependent on total baseline score for energetic arousal. Finally, slopes between contextual variables and pre-event arousal were not moderated at the person-level in either behaviour – in both cases situational modifiers of energetic change demonstrate independence of stable individual factors. It is possible that pre-event increases in alertness reflect attentional focus on/preparatory engagement in the primed behaviour. Such a process might represent associative reward mechanics: appetitive-incentive effects (acting as kindling for further direct effects) in natural reward, and incentive-sensitisation effects in smoking. It might instead represent a general correlate of volitional activity, associated with selecting and being ready to perform a given behaviour (regardless of its associated value/valence).

Elevation of alertness following consumption was only observed in data from the eating diary. Food intake produces elevation of energetic arousal, and incentive effects are thus superseded by direct effects (as a general episodic trend) in a way that was not observed for smoking behaviour. These effects are unlikely to reflect nutrient actions: such changes should occur during or after digestion at a temporal range from 30 to 180 minutes after eating (Macht, Gerer, & Ellding, 2003). Episodes in the present data-set had a mean length of 17.9 minutes, observed mood changes were not related to episode-length, and food-type (reflective of energy content) was not related to consummatory change. Thus observed changes are likely to represent psychological effects of food consumption (Rogers, 1995) such as direct mechanisms of taste reward (cf. Berkowitz, 2000).

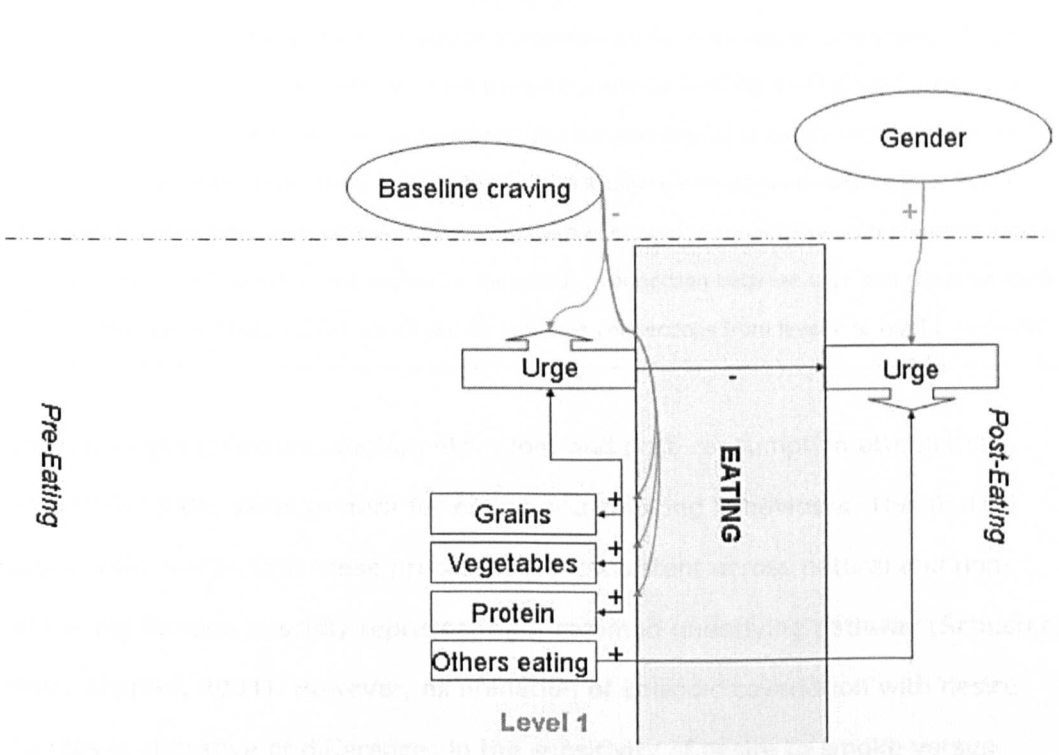
Desire to consume

Figure 7.3 shows two models: one of eating-related urge-change (with covariates and moderators), and the other a reproduction of the parallel smoking-related

model (finalised in the previous chapter). These models are presented together in this figure for convenience of comparison. Discussion in this section pertains to the former model, but particularly considers its similarity (or otherwise) to the latter.

Figure 7.3

Episodic model of urge in relation to food consumption



Episodic model of urge in relation to smoking

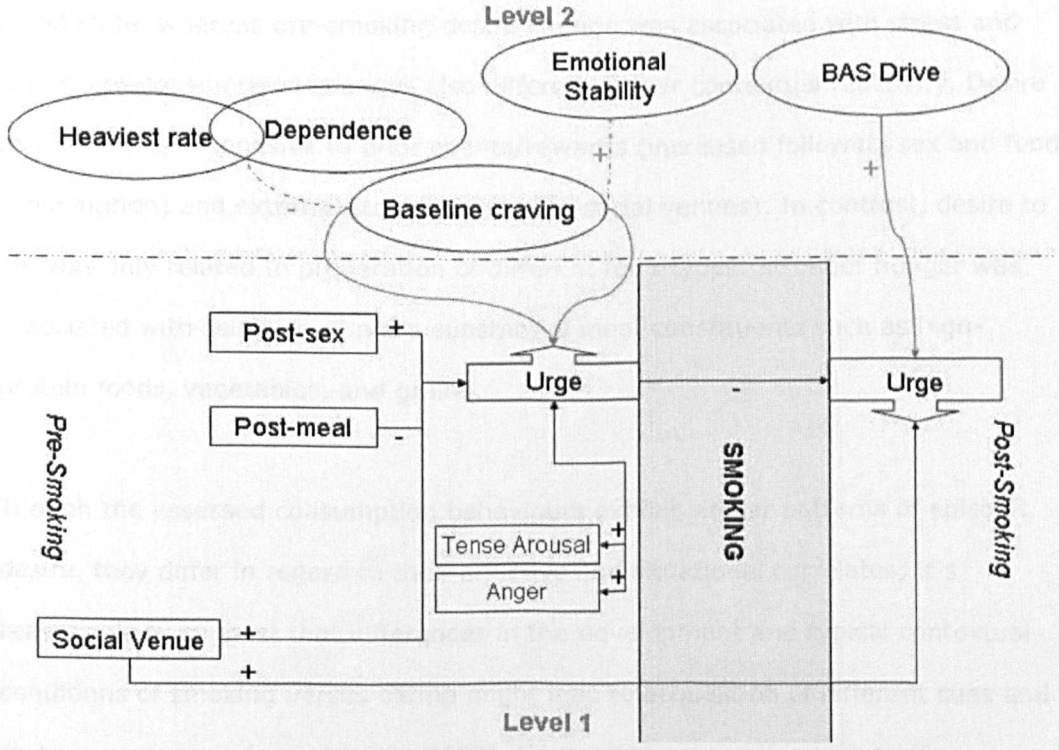


Figure 7.3 presents two episodic models, both representing desire change-covariation at Level 1 and stable moderators at Level 2. The first model pertains to eating episodes (drawing on data in the present chapter); the second is a repeat presentation of the parallel smoking model (from the previous chapter) – shown here to facilitate comparison across consumption behaviours. The novel (food consumption) model conforms to the format of previous smoking models. Box-arrows show increased urge before eating (left of the event) and reduced urge after eating (right of the event). Links between these urge changes and other variables show observed contextual reactivity. For example, pre-consumption increases in craving were enhanced in conjunction with preparation of grain-based foods, and this is depicted by the positive connection between urge and the grain food-type. Moderating relationships are shown by valenced connections from level 2 to level 1 variables.

Desire changes (pre-consumption elevation, and post-consumption attenuation) demonstrated the same pattern for eating and smoking behaviours. This finding supports the notion that these processes are consistent across natural and non-natural reinforcers, possibly representing a common underlying pathway (Schuster, 1990; Glautier, 2004). However, examination of episodic covariation with desire changes is indicative of differences in the sensitivity of desire to smoke versus desire to eat. Increases in hunger before consumption showed no relationship with mood state, whereas pre-smoking desire change was associated with stress and anger. Pre-consumption changes also differed in their contextual reactivity. Desire to smoke was responsive to prior events/rewards (increased following sex and food consumption) and external state (elevated in social venues). In contrast, desire to eat was only related to preparation of different food-types: stronger hunger was associated with selection of more substantial meal-constituents such as high-protein foods, vegetables, and grains.

Though the assessed consumption behaviours exhibit similar patterns of episodic desire, they differ in regard to their affective and situational correlates; it s reasonable to suggest that differences in the development and typical contextual conditions of smoking versus eating might lead to acquisition of different cues and state expectancies (e.g., Niaura, 2000). Comparing covariation with post-

consumption desire-change for eating and smoking, satiation of hunger was reduced when eating with others who were also eating, whereas satiation of desire to smoke was reduced when in social venues. These relationships may have a plausible common interpretation, perhaps reflecting general persistence of desire in particular disinhibitory contexts with sustained sensory cues (Tiffany, 1992) - such as eating when others are also indulging/presenting food-related stimuli, and smoking in environments that may be smoky and conducive to lower restraint/acts of gratification.

In both smoking and eating behaviours, desire appears to be a unitary process such that changes at any stage are largely contingent on preceding desire levels. Apart from relationships with baseline hunger, desire to eat was only moderated by gender, and was specifically moderated at the stage of satiation (males tend to experience lower satisfaction of their desire than females). Smoking-related satiation was also moderated directly, but by BAS drive rather than gender; desire to smoke was also related to neuroticism, and partly reflected dependence experience. These moderating relationships indicate that craving to smoke is more sensitive to individual variability; hunger processes, by contrast, appear to be quite stable across individuals of the same gender. Overall, individual differences appear more pronounced in smoking as opposed to eating related experiences.

7.3.3 Direct comparisons

Figure 7.4 shows the model derived from direct comparative analyses of the combined smoking-eating data-set. Variables discriminating smoking and natural consumption at level 1were derived from hierarchical modelling, with episodic experiences examined as a function of diary-type at level 2. Trait predictors of smoker/non-smoker status were identified in logistic regression analyses. Comparative discussion begins by considering particular features of episodes –

chiefly mood, but also contextual conditions – that differentiate smoking from natural consumption, and finally elaborates potential trait markers of smoker status.

Figure 7.4

Direct comparison: Episodic model of smoking- (versus eating-) related experiences

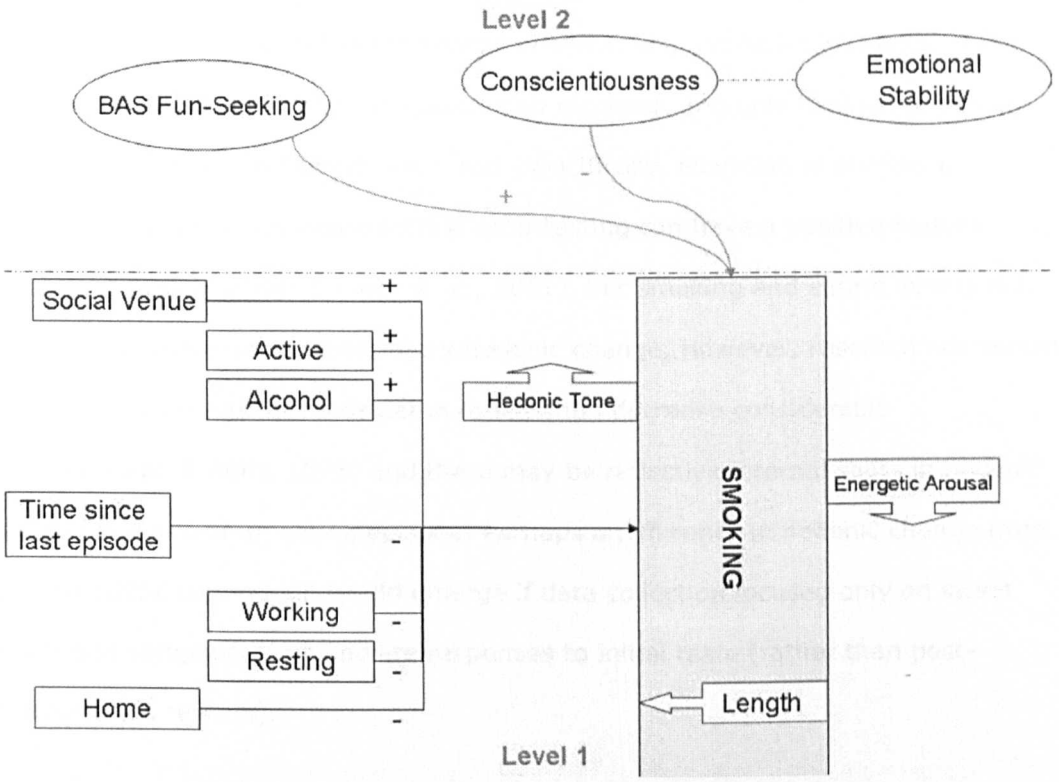


Figure 7.4 depicts variability at levels 1 and 2 that is particularly associated with smoking (versus natural consumption in non-smokers). Thus, variables shown at level 1 are episodic experiences that differentiate smoking from natural consumption behaviour. Variables shown at level 2 are traits that differentiate smokers and non-smokers (based on logistic regression analyses). The model shows that hedonic incentive elevation is an affective experience particular to smoking versus eating. Relative to natural consumption events, smoking is more likely to occur when drinking alcohol, being active, and whilst in social settings (denoted by positive connections) - but less likely to occur when working, resting, and whilst at home (negative connections). Unsurprisingly, smoking episodes are also shown to be shorter in duration than eating episodes. Note that urge changes did not demarcate smoking from eating behaviour. Smokers tend to be higher in BAS (indexed by fun-seeking scale) and lower in conscientiousness, as compared with non-smokers. Smokers also tend towards neuroticism, although the predictive value of this trait is dependent on (low) conscientiousness.

Changes in mood and desire to consume

In the combined data-set, moderation of event-related mood changes by behaviour-type bolstered findings derived from the separate data-sets. Preparatory energetic elevation did not differ between behaviours, but hedonic change at the same stage was specifically associated with smoking, and only food consumption showed potential direct effects on mood (specifically, elevation of energetic arousal). Research has indicated that food-tasting can have a positive hedonic impact (Berridge, 2000; Steiner *et al.*, 2001), but smoking and eating events did not differ in terms of consummatory hedonic change. However, research has shown that hedonic ratings for foods eaten to satiation decrease considerably (Hetherington & Rolls, 1996) and there may be reflective internal shifts in hedonic state at the end of an eating episode. Perhaps a difference in hedonic change from pre- to post-consumption would emerge if data collection focused only on sweet foods and sampling of immediate responses to initial taste (rather than post-consumption reports).

Similarly, parallel findings for desire-change derived from separate eating and smoking diary data-sets were bolstered by analysis of combined data: desire changes were not moderated by behaviour-type.

Context of consumption

Shapiro *et al.* (2002) are the only other researchers to have examined the situational specificity of smoking behaviour using event-sampling methods. They compared context of smoking episodes with context at randomly signalled non-smoking occasions. The present research compared context of different consumption behaviours (and smokers versus non-smokers), but found some similar trends. Relative to eating episodes, the present research found that smoking episodes were more likely to occur whilst drinking and less likely to occur whilst working or studying. Shapiro and colleagues found the same trend in comparing

smoking and non-smoking occasions. Relative to smoking episodes, the present research found that eating events were more likely to occur whilst resting and when at home, and less likely to occur during active tasks and whilst in social venues. Shapiro and colleagues found no differences between smoking and non-smoking occasions for resting, being at home, or active tasks, and they did not distinguish episodes that may have occurred in social venues such as bars, clubs, and restaurants. It is reasonable to suggest that discrepancies between present findings and those of Shapiro *et al.* (2002) are likely to reflect the comparisons applied. The present research specifically contrasted smoking with a control consumption-behaviour, whereas Shapiro and colleagues compared smoking with a random selection of all other behaviours. Furthermore, potential individual differences in context selection between smokers and non-smokers might be reflected in the present findings.

Personality and smoker status

A great deal of research has investigated potential trait differences between smokers and non-smokers, but few consistent relationships have emerged (Smith, 1970; Arai *et al.*, 1997; Shadel *et al.*, 2000). In reviews of the evidence to date, the most reliable trait-marker of smoking status to emerge is psychoticism and related constructs (potentially, lower-order facets; Costa & McCrae, 1992) of impulsivity and sensation-seeking (Gilbert, 1995; Acton, 2003). The present findings derive from personality measures that have rarely been used in this context (despite contemporary support for these instruments; Shadel *et al.*, 2000; Corr, 2001), but show some uniformity with the trend in studies to date. However, non-prospective study of personality differences makes it difficult to determine whether predictors of smoker status pre-dispose smoking vulnerability, or are changes in personality that developed as a result of smoking.

BAS fun-seeking emerged as a trait positively predictive of smoker status. This measure specifically reflects impulsive approach tendencies towards novel stimuli (without reflecting the sociability component of extraversion - in a way that could make interpretation more difficult; Carver & White, 1994) and is supportive of previous research reporting greater impulsivity in smokers versus non-smokers (e.g., Foreyt *et al.*, 1993). The finding that conscientiousness delineates smoker status may also be interpreted as supportive of research indicating that sensation-seeking and conceptually related Eysenckian psychoticism (Eysenck & Eysenck, 1985) are associated with/dispose towards smoker status. In terms of Big Five trait dimensions, psychoticism reflects low conscientiousness and agreeableness (Eysenck, 1992; Goldberg & Rosolack, 1994); furthermore, psychoticism has been defined and implemented as a measure of impulsivity (Acton, 2003). Taken together, there is a suggestion that conscientiousness may link BAS sensitivity and psychoticism, and thus reconcile the two trait-markers of smoker status emergent in the present research. BAS fun-seeking and conscientiousness were negatively correlated in the present studies (-.32), and this relationship might be consistent with recent reformulations of BAS trait-space (Pickering & Gray, 1997).

Considered in the context of previous research that has specifically measured conscientiousness, the present findings show congruency (though see Shadel *et al.*, 2000). Low conscientiousness has been linked with health risk behaviours (Vollrath & Torgersen, 2002), and low conscientiousness in childhood was found to predict smoking in adulthood in a recently reported 24-year prospective study (Kubicka *et al.*, 2001). In one of the few studies to examine smoking in relation to five-factor personality models, and the largest survey to date, Terracciano & Costa (2004) found that conscientiousness differentiated smokers, former smokers and non-smokers: current smokers had the lowest scores, long-term abstainers had intermediate scores, and non-smokers had the highest scores.

7.4 Next chapter

Chapter 8 considers smoking motivations that may be lagged or cumulative over the course of the day, rather than event-contiguous. To this end, Chapter 8 draws upon the fixed-interval component of implemented diary studies. In relevant analyses, consumption frequency and urges (that do not necessarily lead to consumption) can be modelled as outcomes of slower-acting temporal processes. Neither of these outcomes was amenable to testing in episodic modelling. Chapter 8 considers periodic motivation in both smoking and eating behaviours; continuing the comparative approach of the present chapter.

Chapter 8. Periodic variability - craving, consumption, and related experiences

In this chapter, examination of smoking motivation was extended beyond the episodic analyses of previous chapters to look at associations at a more general level of temporality. Recall that the three diary studies of the research were designed to acquire both episodic and interval-contingent data; the present chapter focuses on this latter source of information. Why look at motivation using different measures and intervals of measurement? One reason is that important processes may be difficult to capture using a single approach to temporal sampling (Wheeler & Reis, 1991). Limiting investigation to episodic sampling only allows recording of immediate antecedents and consequences of smoking. An episodic approach does not, for example, permit analysis of smoking frequency – yet understanding of this outcome (and associated experiences/predictors) could have practical implications for smoking reduction and cessation. Adopting a single approach to temporal sampling may artificially restrict derived models of motivation. For example, if the sole focus of investigation is on the brief temporal window within which smoking events occur, an implicit assumption is made: that smoking behaviour is best understood as a series of momentary responses to immediate contextual changes (Shiffman, 1989). An episodic approach inherently limits the predictability of smoking, since more gradual processes and distal motivational cues are discounted. It's possible that smoking intentions build-up over time (Baker, Morse, & Sherman, 1987), or situational constraints mean that smoking responses to motivational cues must be suspended over time (Tiffany, 1995) - for example, a strong urge may occur in a no-smoking area, and only elicit a smoking response later in the day (when the smoker is no longer in a restricted area). Returning to the outcome of smoking frequency, it would be beneficial to look at this variable over specific periods of time (for example, each day in a week) and see whether variability in

smoking rate is related to variability in other measures over the same period of time. Better still, investigation of periodic data allows cross-lagged analyses to be performed: if stress in period 1 predicts smoking in period 2, and smoking in period 1 does not predict stress in period 2, a causal sequence is implied (lagged from stress to smoking).

Chapters 5 and 6 considered episodic smoking motivation and its moderation by personality respectively. Chapter 7 compared the derived hierarchical model of smoking motivation with parallel data from the food consumption diary. The present chapter combines conceptual and analytical approaches from the three preceding chapters and applies them to periodic diary data. Thus, the general sequence of investigation in this chapter begins with examination of periodic smoking motivation (within-persons analysis), proceeds through characterisation of relevant trait moderation, and concludes with comparison of models for smoking versus eating.

Definition of periods

Days were divided into two periods by a fixed-interval assessment design: at each assessment point, participants were asked to recall experiences over the preceding period (since the last assessment point). They also provided reports of their current feelings (at assessment point) in one variation of this design (the quasi-interventional study). Period selection was based on indications from piloting as to what intervals would be most convenient for - and sensitive to the schedules of - the sampled student population. Fifteen students recorded their timetable for a day (reporting activities hour by hour from waking to sleeping), so that convenient assessment points could be identified. As a result of this piloting, assessment points were programmed for 12pm and 8pm of each day, producing periods from 8pm to 12pm (of the next day) and 12pm to 8pm. This programme allowed for the high variability in sleeping and activity patterns evident in this sub-population, such that

day and evening measures would not be too early/late for the assessment schedule to be met.

Outcomes of interest at the periodic level

Episodic analyses were intrinsically tied to smoking events, but periodic analyses require the specification of smoking-related outcomes. Two main outcomes were examined to this end: smoking frequency and craving experiences (frequency, intensity, and duration). Smoking frequency represented the number of cigarettes smoked in a given period, facilitating examination of experiences that motivate increased or decreased smoking behaviour. Craving was measured because experiences may motivate a person towards smoking – increasing the frequency, intensity and duration of urges to smoke – without necessarily leading to smoking behaviour (Tiffany, 1990; Toneatto, 1999a). Smokers may not respond to every urge (for example, situational restraints could defer the act): in these situations, smoking frequency (or indeed, episodic measures of consumption) would not be sensitive to motivations. Cues that elicit the desire to smoke, but do not consistently trigger the act of smoking, could be over-looked. Although periodic smoking frequency and craving were examined as separate outcomes, the inter-relationship of these variables was an important consideration. How reliably do craving experiences relate to actual smoking behaviour? Craving is cited as a prominent experience in dependence, but there is evidence to suggest that it is poorly predictive of actual behaviour. As has been discussed, craving is likely to be influenced by affective motivation, and it is possible that craving may partially mediate any mood regulation by smoking. Craving and the urge-smoking relationship are thus important outcomes for the present research, relevant to its focus on mood and affective personality in smoking.

Measures of periodic motivation

Measures of motivation at the periodic level were intended to compliment episodic measures, and reflected findings in the initial survey study regarding affective and behavioural associations with smoking. Participants rated the hedonic value of the most salient pleasant and unpleasant events that they experienced in each period. This provided measures of the hedonic tone of periodic experiences, tying recall to specific events (a useful mnemonic aid). Participants also recorded their perceived stress over the preceding period (as an indicator of tense arousal) and their ability to focus/concentrate (as an indicator of energetic arousal). In this way, periodic measures were adapted to tap variability that is conceptually related to the three main dimensions of affect examined in the present research.

Alcohol consumption, tea/coffee consumption, and the influence of passive exposure are other theoretically relevant smoking-related variables (Gilbert, 1995; Cooney *et al.*, 1998; Shadel *et al.*, 2001; Olsen, 1991) that were identified as potential cues in the initial survey study and measured in episodic analyses. These variables were also measured in the periodic analyses, to better contextualise smoking behaviour and its relationship with mood/affective personality. Representation of variability at both periodic and episodic levels of temporality was not considered to be redundant. For example, episodic measures of consumptive company (being with others who are smoking simultaneously) allow insight into an acute coincidence, but periodic measures of exposure to others smoking might reveal associations outside of the episodic timeframe – perhaps even lagged over an entire day.

Predictions

Based on episodic modelling in the preceding chapters, it may be hypothesised that positive hedonic experiences (high-salience pleasant events and low-salience unpleasant events) should relate to smoking frequency. Episodic models indicated

that hedonic mood can be regulated by smoking; it follows that periods when people smoke more may be periods when pleasant events will seem more pleasant and unpleasant events less unpleasant. A further implication of hedonic regulation here is that a lagged relationship could arise: periods characterised by less pleasant experiences may lead to greater smoking in the next period, as a compensatory action. According to incentive-based theories, the reverse relationship (periods of greater smoking leading to periods of less pleasant experience) should not be present as increased smoking should further sensitise receptivity to positive hedonic experiences (Robinson & Berridge, 1993; Koob, 1999; Ternes, 1977). A related prediction is that positive hedonic tone will be greater following periods of increased smoking (in the quasi-interventional study). This prediction is predicated on findings that hedonic tone was elevated from baseline by smoking (an incentive-sensitisation effect), and that the extent of this elevation increased with consecutive smoking episodes.

It is possible that periodic alertness and fixed-interval measures of energetic arousal (quasi-interventional study) will demonstrate relationships with smoking frequency that are similar to those hypothesised for hedonic experiences. This possibility is based on the identified role of energetic arousal in incentive-sensitisation of episodic smoking. However, analyses of natural consumption data indicated that energetic arousal may be more generally elevated by approach behaviours; also, energetic elevation did not sensitise over consecutive smoking events. It may then be less likely that specific periodic associations between smoking and ability to concentrate or energetic arousal are evident. For example, other energy arousing activities (say, working or eating) may increase during times when smoking frequency is decreased (such as when in no-smoking workplaces/restaurants); this would mask any periodic relationship between smoking and ability to focus.

It is not clear how episodic incentive-sensitisation findings impact on predictions regarding periodic cravings. Hedonic tone and energetic arousal did not show any relation with desire to smoke, at the episodic level. The episodic slope between tense arousal and desire to smoke may however suggest that craving will be greater in periods when perceived stress is greater. Interval tense arousal and anger (in the quasi-interventional study) may be related to preceding or subsequent periodic craving, but it is difficult to extrapolate further. An important prediction is that craving should be related to smoking in the same period. A close relationship between desire to smoke and behaviour would make craving (and related cues) a practical target for intervention, in a predictable behavioural process. Desire to smoke was strongly reactive to smoking in episodic analyses (pre-smoking elevation, post-smoking satiation), but it remains to be seen whether urges lead to smoking – episodic models can only be informative about the events that do occur (and not desires that are resisted).

Comparisons of smoking and eating showed that alcohol is specifically associated with smoking behaviour. It was thus predicted that smoking would be more frequent in periods when greater quantities of alcohol were consumed. There was no evidence in episodic analyses that tea/coffee consumption relates to smoking or craving. However, it was anticipated that passive smoke exposure may increase smoking frequency and/or craving in the same period. Previous analyses have shown that smoking behaviour and urge are associated with being in a social venue; this relationship may partly reflect the effects of smoke exposure. However, being around others who are smoking was not shown to increase urge in these prior analyses – this may have been a more direct measure of the influence of passive smoke

Due to the hierarchical nature of modelling, predictions of personality effects were difficult to specify. Moderating influences were only examined for significant slopes

at the periodic level, so much depended on the outcomes of covariation models. Taking smoking frequency and craving as direct outcomes of personality, hypotheses generation remained problematic. Comparisons of smokers and non-smokers in the preceding chapter indicated that high BAS (fun-seeking) and low conscientiousness disposed smoking behaviour between persons. These traits may similarly predict the severity of smoking – high BAS and highly conscientious individuals may smoke more and/or experience more pronounced craving - but this does not necessarily follow from episodic findings, or the wider literature (Gilbert, 1995; Kassel *et al.*, 2003; Gilbert & Warburton, 2003; Dierker *et al.*, 2001). Vulnerability factors for smoking acquisition may not influence the severity of dependence as though along a spectrum from non-smoking to heavy smoking (Heath *et al.*, 1995). In line with the position that smoking is a rewarding/approach behaviour, it was generally predicted that trait moderation – where evident – would involve the BAS and related dimensions of the big five.

Finally, in terms of comparisons between smoking and eating behaviours at the periodic level, previous findings suggested that derived models would have very different mechanisms/sensitivities. Eating behaviour is likely to show less reactivity to the behavioural and motivational variables assessed, and relatively minimal moderation at the trait level: producing a less complex model. Commonalities were expected in the inter-relation of craving experiences and actual consumption, however.

In summary, central aims of this chapter were:

1. To examine periodic smoking frequency and craving as principal outcomes.
    a. How do these outcomes relate to each other? Does craving reliably predict smoking? If so, does craving mediate other smoking cues such as affective experiences?

b. How do these outcomes relate to affective experiences (hedonic events, perceived stress, and distractibility) in the context of other potential cues (such as alcohol consumption and passive smoke exposure)?

c. Are the relationships in (a.) and (b.) lagged over time? Cross-lagged analyses were performed to uncover temporal antecedents and consequences of increases in smoking frequency or craving.

2. To examine effects of periodic smoking and craving on ensuing mood - and relate them (and other observed periodic effects) to episodic mood-smoking relationships. Is hedonic elevation by smoking evident over periods of time beyond the episodic timeframe?
3. To compare resultant models with those observed for eating behaviour. Are smoking and eating behaviours sensitive to different motivations (as evinced in episodic analyses)?

8.1 Investigatory Approach

8.1.1 Periodic craving and smoking frequency

Models at this stage of analysis were based upon fixed-interval data from the initial smoking-diary study only.

Concurrent relationships

These analyses were structurally similar to previous models of level-1 covariation without conditions at level 2, such as the analyses of mood-context relationships in Chapter 5. Slopes for smoking frequency and craving were the main outcomes of interest in these analyses. Craving scores represented the sum of sub-scores for the frequency, intensity, and duration of periodic craving experiences. Craving measures were found to be highly inter-correlated (> .6), so relevant scores were combined to give a general craving score (α = .79) - with higher values reflecting

greater periodic craving. Smoking frequency and craving scores were systematically examined as a function of all other periodic variables (separate models were constructed for each potential covariate). Variables were group-mean centred, and correlated measures were jointly re-entered into models so as to identify independent relationships. As smoking frequency was not recorded prior to the first reflective fixed assessment, data from only four of the five data-points was examined in the present analyses (a total of 168 level 1 units from 42 units at level 2) The complete set of periodic variables examined (including the primary outcomes) are shown in Table 8.1 As with craving scores, separate values for the frequency, intensity, and duration of exposure to others smoking (correlations > .5) were combined to give a general passive exposure score (α = .82) – with higher values reflecting greater periodic exposure.

Lagged relationships

Although the present research design was not applied to examine causal relationships explicitly, modelling of lagged associations can facilitate insight into mechanisms of causation (West & Hepworth, 1991). Variability in smoking-related outcomes might demonstrate sensitivity to more distal preceding experiences (further to period-concurrent and acute-episodic contingencies). If such lagged relationships are in operation, it is easier to test for their directionality (and make inferences about causality) than it would be for relationships only observed at the same temporal stage.

Accordingly, a series of models were constructed wherein smoking frequency was systematically examined as a joint function of smoking frequency in period i-1 and one other variable in period i-1 (separate models were constructed for all potential lagged covariates). In parallel, a series of models were constructed with craving as the main outcome. Finally, analyses were conducted in which significant lagged predictors identified from the preceding models were examined as a function of

smoking frequency-1 or craving-1 as appropriate. For example, to determine whether alcohol-unit consumption led to or was followed by changes in smoking frequency, the following two models were analysed:

$$\text{SFREQ (period i)}_{ij} = \beta_{0j} + \beta_{1j}\,(\text{SFREQ period i-1}) + \beta_{2j}\,(\text{ALC period i-1}) + r_{ij}.$$

$$\text{ALC (period i)}_{ij} = \beta_{0j} + \beta_{1j}\,(\text{SFREQ period i-1}) + \beta_{2j}\,(\text{ALC period i-1}) + r_{ij}.$$

The critical coefficients in these models are the lagged coefficients β_{2j} (ALC period i-1) in the first equation and β_{1j} (SFREQ period i-1) in the second. A causal sequence from alcohol consumption to smoking frequency is suggested if the (ALC period i-1) coefficient is significant and (in subsequent analysis) the β_{1j} (SFREQ period i-1) coefficient in the second equation is not significant. For the analyses of lagged relationships, two consecutive complete data points were required, necessitating that these models were based on one less data point than preceding analyses of concurrent relationships (126 level 1 units).

Moderation of craving, smoking frequency and related slopes

At this stage of analysis previous models were made conditional at level 2, to identify person-level moderators of periodic craving and smoking frequency, and of their relationships with other periodic variability (concurrent and lagged). Trait variables examined were those applied in previous analyses relating to smoking behaviour (see Table 6.1). Correlated moderators were jointly re-entered into models so as to identify independent relationships.

Table 8.1

Periodic measures: Smoking and food consumption

Smoking	Food Consumption
Smoking frequency	Eating frequency
Urge to smoke	Urge to eat
(composite of frequency, duration and intensity)	(composite of frequency, duration and intensity)
Passive exposure	Passive exposure
(composite of frequency, duration and intensity)	(composite of frequency, duration and intensity)
Perceived Stress Scale	Perceived Stress Scale
Pleasantness of experience	Pleasantness of experience
Unpleasantness of experience	Unpleasantness of experience
Ability to focus	Ability to focus
Alcohol unit consumption	Alcohol unit consumption
Tea/coffee consumption	Tea/coffee consumption

8.1.2 Periodic variability in food consumption

The programme of analyses applied to fixed-interval smoking-diary data was subsequently applied to equivalent data from the diary of eating behaviour. Analyses examined concurrent and lagged slopes for craving (urge to eat) and eating frequency, and moderation of all relevant outcomes by person-level variability. Trait variables examined were those applied in previous analyses relating to eating behaviour (Table 8.1). Correlated moderators were jointly re-entered into models so as to identify independent relationships. The number of units at level 1 and 2 replicated preceding analyses of smoking-related patterns: beginning at 168 and 42 for analyses of concurrent periodic slopes (four data points).

8.1.3 Current mood in relation to periodic craving and smoking frequency

A final set of analyses utilised fixed-interval data from the quasi-interventional diary to examine how current mood (at response interval) might relate to preceding and subsequent periodic variability in craving and smoking. Data on current mood at fixed-interval was only collected in the quasi-interventional diary. These models looked at relationships between current mood (EA, HT, TA, and AF) and craving/smoking frequency: testing whether mood reported at interval was predicted by preceding craving/smoking and/or predictive of craving/smoking in the subsequent period. Logically, the former of these relationships was examined with mood dimensions as main outcomes in relation to craving and smoking frequency. Derived t-ratios are the same whichever variable is made the main outcome in covariant analyses, but current mood might better be conceptualised as an outcome of preceding smoking/craving (rather than the reverse) so as to reflect temporal sequence. By the same reasoning, lagged relationships were examined with smoking frequency and craving as main outcomes in relation to mood-1: recalled smoking and craving experiences were subsequent to mood reports in these analyses. Furthermore, due to the temporal process inherent in these analyses, a directional process might be inferred if covariation in concurrent relationships is not replicated in lagged relationships.

Theses models were subsequently extended at level 2 to examine person-level moderation of significant covariation as before. For each subject, only data from five of the seven recorded periods (160 level-1 units) could be analysed to examine relationships between current mood (at time of reporting) and preceding craving. This is because reports at the end of two periods would reflect experiences during the encouraged-abstinence period (see Chapter 9). Usable data for analysis of relationships between current mood and preceding smoking frequency was further

limited - to four periods, or 128 level-1 units - as smoking frequency was not recorded prior to the first fixed assessment. Finally, for analyses pertaining to lagged relationships, the requirement for data from consecutive periods in addition to the aforementioned constraints meant that three periods were analysed for craving-1 (96 level-1 units) and two periods for smoking frequency-1 (64 level-1 units).

8.2 Results

8.2.1 Periodic craving and smoking frequency

Concurrent relationships

Craving to smoke tended to be greater during periods when more alcohol was consumed (γ_{10}= .42, t= 3.22, p = .003). Craving was not related to other measures of periodic variability. Smoking frequency tended to greater during periods when more alcohol was consumed (γ_{10}= .21, t= 3.72, p = .001) and during periods when unpleasant experiences were less intense (γ_{10}= -.21, t= -2.21, p = .03). Frequency of smoking was not related to other measures of periodic variability. Positive relationships between the central outcomes and alcohol consumption were anticipated (urge was not related to alcohol consumption at the episodic level, but drinking was shown to be strongly associated with smoking episodes). However, though craving and smoking frequency showed similar relationships with alcohol use, they did not covary with each other. The lack of association between cravings and smoking (though foreseeable) was not predicted, and undermines the usefulness of craving as a behavioural predictor. On the other hand, the relationship between the negative salience of unpleasant events and smoking frequency does show congruence with predictions. Episodic findings demonstrated the usefulness of smoking as a regulator of hedonic experience – the

present relationship may reflect a mood congruency effect, with unpleasant events perceived as less negative during times when smoking has been more frequent.

Lagged relationships

These analyses found that reduced pleasure in one period (period i-1) predicted frequency of smoking in the next period (period i) (γ_{10}= -.40, t= -3.46, p = .002), above and beyond the relationship between smoking frequency in period i-1 and period i. In contrast, smoking frequency in one period was not significantly related to pleasure in the next period. This pattern suggests that a lack of salient pleasure experiences leads to increases in smoking frequency but not the reverse. Such a relationship is consistent with predictions based on previous episodic analyses: smoking can be used to regulate hedonic experiences, and it follows that smokers may use the behaviour to attain greater pleasure following a relatively un-stimulating period. No other lagged relationships were evident for smoking frequency or craving.

Moderating effects: direct relationships with craving and smoking frequency

Periodic craving was found to be positively related to baseline craving (γ_{01}= .41, t= 2.79, p = .008), heaviest rate of smoking (γ_{01}= .19, t= 2.18, p = .04), and Fagerström dependence score (γ_{01}= .25, t= 2.04, p = .05). Individuals who were more dependent, those who had a history of heavier smoking, and those who reported greater urge to smoke at baseline tended to experience more craving during sampled intervals. Dependence score and heaviest smoking rate were correlated, and neither measure remained significant when entered jointly into models of moderation. This suggests that shared variance of these measures (possibly reflecting the development of more intensive smoking) is responsible for observed individual moderating relationships.

Smoking frequency was positively related to perceived addiction (γ_{01}= .33, t= 2.82, p = .008), heaviest rate of smoking (γ_{01}= .07, t= 2.16, p = .04), and Fagerström dependence score (γ_{01}= .11, t= 2.32, p = .03). Individuals who were more dependent, those who had a history of heavier smoking, and those who reported greater perceived addiction to smoking tended to smoke more during sampled intervals. These measures were all correlated, and none remained significant when entered jointly into models of moderation – suggesting the influence of shared variance underlying trait-like indicators of smoking severity.

Findings for direct moderation were somewhat uninformative – low-level traits that are specifically reflective of smoking behaviour predicted smoking outcomes, but stable universal traits were not implicated. BAS levels were not systematically related to smoking frequency or craving experiences; similarly, the big five trait dimensions did not consistently dispose individuals to greater smoking or craving.

Moderating effects: concurrent relationships

The strength of the positive within-period relationship between alcohol and craving was negatively related to perceived addiction (γ_{11}= -.26, t= -4.00, p < .001) and Fagerstrom dependence score (γ_{11}= -.13, t= -3.55, p = .001). When these correlated measures were entered jointly into modelling of alcohol-craving covariation, only perceived addiction remained significant. The observed cross-level interactions indicated that individuals reporting a stronger belief that they are addicted showed less reactivity between their alcohol consumption and craving. This might indicate that individuals with greater perceived dependence crave more consistently across situations - such that they are less sensitive to alcohol consumption in their urges to smoke. Another possible interpretation is that these individuals are less likely to drink in response to urges to smoke.

The strength of the positive relationship between alcohol and smoking frequency was negatively related to baseline QSU (γ_{11}= -.14, t= -2.70, p = .01), desire to quit (γ_{11}= -.08, t= -2.57, p = .01), BAS Drive (γ_{11}= -.10, t= -2.57, p = .01), and positively related to BAS Reward Responsiveness (γ_{11}= .09, t= 2.11, p = .04). These interactions suggested that individuals with higher baseline craving, those with a greater desire to quit, and those with greater approach impetus showed less reactivity between their alcohol consumption and smoking rate. In contrast, individuals with greater reward responsiveness in their approach sensitivity demonstrated more reactivity between period-concurrent drinking and smoking behaviours.

The strength of the negative relationship between unpleasantness of periodic experience and smoking frequency was positively related to conscientiousness (γ_{11}= .04, t= 2.61, p = .01). The observed interaction indicated that more conscientious individuals showed less reactivity between experienced unpleasantness and smoking reactivity. This might suggest that individuals with greater conscientiousness are less likely to be affected by recent smoking rate in their appraisal of the unpleasantness of recent experience, whereas less conscientious individuals might assess situations as less painful when they have smoked more. Another possible interpretation is that more conscientious individuals smoke more in response to more saliently unpleasant situations (perhaps indicating a tendency to limit smoking except during times marked by more intensely unpleasant experiences).

Moderating effects: lagged relationships

The strength of the negative lagged relationship between pleasure in one period and smoking frequency in the next was not related to variability at the person level.

8.2.2 Periodic variability in food consumption

Concurrent relationships

Urge to eat tended to be greater during periods when participants reported more exposure to others eating (γ_{10}= .15, t= 2.19, p = .04). Craving was not related to other measures of periodic variability. Eating frequency also tended to greater during periods when participants reported more exposure to others eating (γ_{10}= .03, t= 2.41, p = .02). Frequency of consumption was not related to other measures of periodic variability.

Lagged relationships

These analyses found that perceived stress in one period (period i-1) predicted food craving in the next period (period i), above and beyond the relationship between craving in period i-1 and period i. In contrast, craving in one period was not significantly related to perceived stress in the next period. This pattern suggests that greater perceived stress leads to decreases in desire to eat but not the reverse.

Furthermore, alcohol consumption in one period predicted food consumption in the next (γ_{10}= .08, t= 2.53, p = .02), above and beyond the lagged relationship for eating frequency from one period to the next. In contrast, food consumption in one period did not predict alcohol consumption in the next. This pattern suggests that alcohol consumption leads to increased food consumption but not the reverse.

Moderating effects: direct relationships with craving and consumption frequency

Periodic food craving was found to be positively related to QEU Factor 2 (γ_{01}= 2.78, t= 2.60, p = .01) and BAS Drive (γ_{01}= 1.04, t= 2.70, p = .01). Individuals with greater approach impetus and those who reported greater negative urge to eat at baseline tended to experience more craving during sampled intervals.

Eating frequency was positively related to Surgency (γ_{01}= .03, t= 3.15, p = .004), and negatively related to diet attempts (γ_{01}= -.07, t= -2.22, p = .03) and desire to diet (γ_{01}= .09, t= -2.50, p = .02). Individuals who were more introverted, those with a history of dieting, and those with a greater desire to change their eating behaviour tended to eat less during sampled intervals. Desire to diet and number of previous diet attempts were correlated, and neither remained significant when entered jointly into models of moderation – suggesting the influence of shared variance reflecting restricted eating.

Moderating effects: concurrent and lagged relationships

The only moderating effect found for periodic covariation pertaining to urge to eat and episodic frequency of eating was an influence on the lagged relationship between alcohol consumption and eating frequency. The strength of the positive relationship between alcohol consumption and eating frequency was positively related to Surgency (γ_{11}= .01, t= 2.02, p = .05). The observed interaction indicated that more extraverted individuals showed a greater tendency to increase their eating frequency after drinking alcohol.

8.2.3 Mood at interval in relation to periodic craving and smoking frequency

The only covariation identified between mood and periodic smoking outcomes was a positive relationship between current hedonic tone (at fixed-interval assessment point) and preceding smoking frequency (γ_{10}= .15, t= 2.28, p = .03). Taken with the finding that lagged mood did not predict smoking frequency, this suggests that periods of more repeated smoking lead to greater contentment: on average, consuming seven cigarettes in an interval increased subsequent reported happiness by one scale-unit. This relationship remained significant when previously identified

covariates of smoking frequency (alcohol and unpleasantness of experience; both predictive of interval-happiness in the current data) were entered jointly into modelling of hedonic tone as a function of preceding smoking frequency.

The strength of the positive relationship between periodic smoking and subsequent reported happiness was positively related to heaviest rate of smoking (γ_{11}= .04, t= 2.19, p = .04). The observed interaction indicated that individuals with a history of heavier consumption were happier following periods of more intensive smoking behaviour.

8.3 Discussion

With regards to the principal aims of the present chapter:

1. Smoking frequency and craving were not directly related, although parallels were evident in their periodic relationship with alcohol consumption and direct moderation by individual variability.
2. Emergent models of eating frequency and urge to eat did not resemble those surfacing in relation to smoking, although craving and consumption were again found to be unrelated.
3. Periodic smoking had a positive effect on ensuing happiness. Furthermore, modelling of concurrent and lagged periodic relationships suggested that smoking could serve to regulate the hedonic value of positive and experiences. Taken together, these findings supported mood-smoking associations observed in episodic modelling.

Figures 8.1 and 8.2 show derived hierarchical models of periodic variability in smoking frequency and craving (exclusive of associations with interval mood in the quasi-interventional data-set); figures 8.3 and 8.4 show comparison models

relating to food consumption. Chronological periods are distinguished (Period 1, Period 2) to depict relationships that are lagged over time. Note that connections between variables in different periods run in only one direction – reflecting the findings of cross-lagged analyses. Connections within the same period of time are depicted as bidirectional, as the precise temporal order of these within-period relationships could not be determined. Moderating relationships are shown as influencing level 1 relationships from level 2. The nature of all relationships is conveyed by valence symbols proximal to connections.

Figure 8.1

Model of periodic smoking frequency

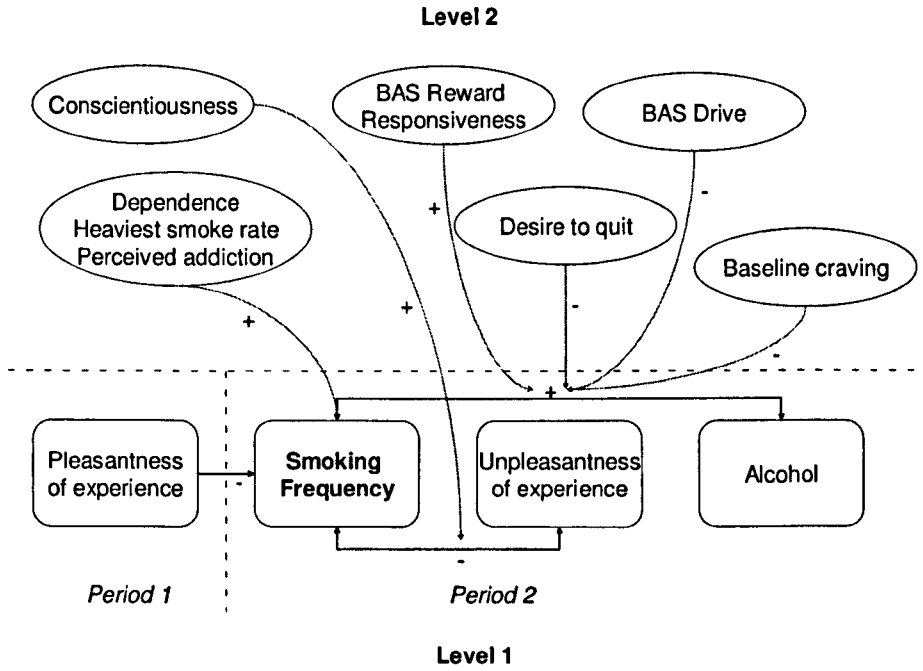


Figure 8.1 represents periodic covariation with smoking frequency at Level 1 of the model (below the dividing line) and stable moderators of these relationships at Level 2 (above the dividing line). The model shows that periods of less pleasure lead to periods of more frequent smoking. Smoking frequency is also greater in periods where alcohol consumption is greater, and in periods when unpleasant experiences are less salient. Note that various L2 variables moderate *covariation* between smoking frequency and alcohol use; in contrast, the shared variance of dependence, heaviest rate, and perceived addiction directly moderates smoking frequency as an outcome.

Figure 8.2

Model of periodic urge to smoke

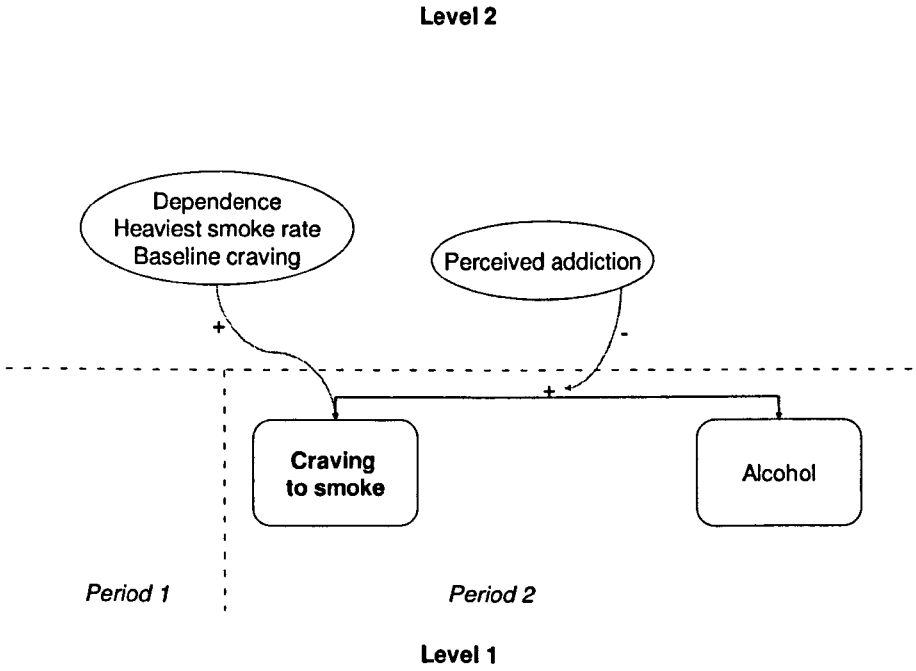


Figure 8.2 represents periodic covariation with craving experiences (reflecting frequency, intensity, and duration of urge episodes) at Level 1 of the model and stable moderators of these relationships at Level 2. Relationships in this model are depicted using the format discussed for Figure 8.1, but with craving as the principal outcome. The simplicity of this model indicates that measured periodic variables showed little systematic covariation with craving. Craving is greater in periods when alcohol consumption is greater. Moderating connections show that craving-drinking reactivity is reduced in individuals who perceive they are more addicted to smoking, and that periodic craving experiences are more pronounced in those with a combination of high dependence, high baseline craving, and a history of heavy smoking.

Figure 8.3

Model of periodic eating frequency

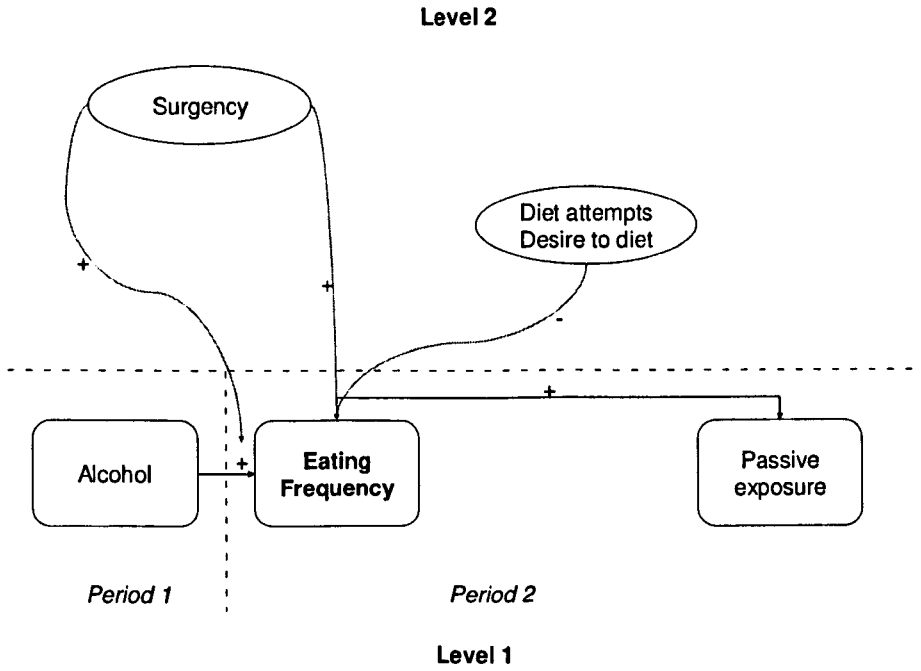


Figure 8.3 represents periodic covariation with eating frequency at Level 1 of the model and stable moderators of these relationships at Level 2. Relationships in this model are depicted using the format discussed for Figure 8.1, but with eating frequency (data drawn from the comparative consumption study) as the principal outcome. The presented model of eating frequency (periodic covariates and relevant moderators thereof) is less complex than the model derived for smoking frequency. Indications are that food consumption is associated with/driven by distinct mechanisms, in comparison with smoking (and this distinction may have implications for understanding differences between natural consumption behaviours and substance use). Eating frequency increases following periods of heavy drinking, and this trend is stronger for more surgent individuals. Within-period, increase in consumption frequency co-occur with increases in exposure to/awareness of others eating. In terms of direct moderation of consumption, more surgent individuals tend to eat with greater frequency, and those who have a stronger inclination towards dieting (individuals with both experience of dieting and current desire to diet) tend to eat less often.

Figure 8.4

Model of periodic urge to eat

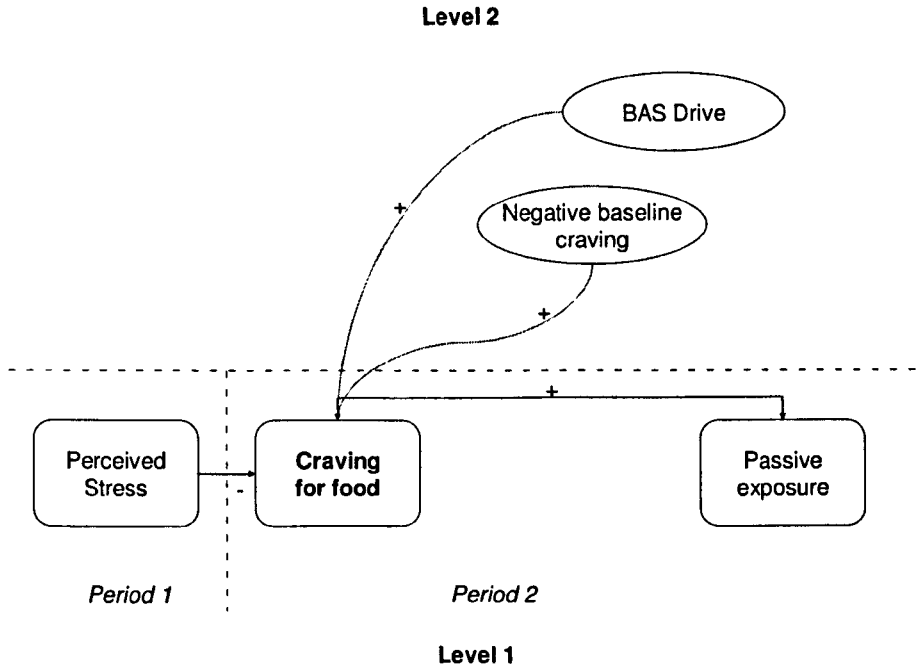


Figure 8.4 represents periodic covariation with food craving experiences (reflecting frequency, intensity, and duration of urges to eat) at Level 1 of the model and stable moderators of these relationships at Level 2. This model is parallel to the smoking-related model shown in Figure 8.2. Though identified relationships in these models are distinct, a notable commonality is the lack of association between craving and consumption behaviour in both smoking and eating. Food craving is greater in periods when exposure to others eating is greater, and is suppressed following periods of greater perceived stress. Moderating connections show that periodic craving experiences are more pronounced in those with high levels of BAS drive, and those who report more negative craving (urgent desire to eat and perception of food as an attenuator of negative mood) at baseline.

8.3.1 Parallels between periodic craving and smoking

The main outcomes examined in analyses of periodic smoking behaviour - smoking frequency and craving processes - do not appear to be directly related. This finding is consistent with previous research indicating that there is a weak link between craving and substance-seeking/consumption (Pickens & Johanson, 1992; Tiffany,

1995). This relationship might be stronger during periods of abstinence (Killen & Fortmann, 1997; Chapter 9), but appears epiphenomenal during everyday maintenance behaviour.

Though not associated with each other, craving and smoking frequency do both demonstrate positive association with period-concurrent alcohol consumption (the finding of a craving-alcohol link that was not evident in episodic analyses supports the notion that varying the temporality of process investigation can facilitate novel insights). It may be difficult to determine the directionality of reactivity in these contemporaneous relationships, but this finding shows consistency with evidence for the strong association between cigarette smoking and alcohol use (McClure *et al.*, 2002; Fertig & Allen., 1995). Recent research examining cross-sensitisation of alcohol and tobacco cravings found that alcohol cues elicited increased urge to smoke but not the reverse (Cooney *et al.*, 2003): this finding might offer some insight into the directionality of the presently observed alcohol-craving relationship, indicating that urges to smoke are more likely to emerge from alcohol consumption than the reverse. The lack of connection between smoking and craving means that this inference cannot be extended to the observed alcohol-smoking association.

Numerous studies have shown that alcohol consumption leads to acute increases in tobacco consumption, but little research has examined the reverse relationship (Drobes, 2001). Perkins *et al.* (2000) offered some indication that the reverse relationship may emerge, conditional on gender and an initial dose of alcohol: smoking increased responding to obtain alcohol after consumption of an alcohol "pre-load", but not before the pre-load and only in male smokers. The absence of gender moderation in the presently observed relationship, and the technical implication that alcohol consumption is more likely to drive smoking than the reverse in the initial stages of interaction, facilitates a tentative suggestion about directionality. The observed relationship is likely to emerge from drinking behaviour

in the first instance (as it is more likely to for craving) – although the consumption behaviours may well feedback to each other subsequently. Episodic analyses indicated that alcohol use enhances hedonic elevation when smoking. Alcohol consumption may drive smoking frequency by enhancing sensitivity to approach-related mood (hedonic incentive salience). Through cross-sensitisation (Self, 1998), this kindling effect might be similar to reported effects of appetitive pre-dosing (e.g., Shaham *et al.*, 1997) – where a small pre-load of drug of choice primes repeated self-administration.

Smoking frequency and craving appear to be directly influenced by similar variability at the person-level. Variability reflecting dependence history and related perceptions was positively related to smoking frequency; variability reflecting dependence history and general craving was positively related to smoking urges. As smoking-specific traits are essentially summaries of high behavioural frequency and craving, these associations are perhaps not particularly insightful. However, relationships like this contribute to the validation of data collected – suggesting that the diary protocol did tap variability reflected in global reports with some accuracy. Furthermore, these findings reinforce the notion of consumption and craving processes having parallel influences despite a lack of inter-relationship. However, associations with alcohol consumption were moderated by different traits. Craving-alcohol reactivity was reduced in individuals who reported more perceived addiction. Smoking-alcohol reactivity showed sensitivity to numerous independent moderators: enhanced in individuals who were more reward responsive, but attenuated in those with greater approach drive, those with greater desire to stop smoking, and those with higher generalised craving.

The distinction in BAS-related moderation of this relationship is interesting, indicating that sensitivity to approach-related reward may encourage positive feedback between certain behaviours (i.e., experiencing one reward sensitises

another) whereas approach impetus might dispose a more general behavioural drive less reactive to contemporaneous influences. In the development of their BIS-BAS scales, Carver and White (1994) suggested that the specific nature and applicability of their four subscales would emerge over the course of future research. The present findings indicate that these subscales do have differential sensitivities that might be obscured (in measurement and interpretation) by the application of a summated BAS score. Notably, smoking frequency was not directly related to BAS. Low BAS individuals exhibited stronger incentive effects, but this did not apparently translate into more frequent behavioural activation However, without knowing the frequency of smoking preparations/incentive effects that did not lead to smoking, there is little reason to suggest that such an effect should be uncovered.

8.3.2 Contrasts with periodic food consumption

As in episodic comparisons, processes relating to eating and smoking appear quite distinct: both in terms of associations at the same temporal level and moderation by individual variability. One similarity is that urge and frequency of consumption did not covary with each other in either behaviour. Clearly there is not a complete correspondence between wanting and acting in either behaviour. This could reflect a U-function relationship with low and high frequency consumption positively related to craving. Some researchers have emphasised that urge is most pronounced when consumption is obstructed (Tiffany, 2000); yet it has also been shown that increased urge does accompany consumption when it occurs (episodic analyses). A further similarity is that (in both behaviours) urge and frequency were positively related to a third periodic variable despite their lack of inter-relationship: alcohol use in the case of smoking, and passive exposure in the case of food consumption.

Food consumption was not related to the salience of positive or negative hedonic experiences (concurrent or lagged), and this suggests that the sampled natural behaviour is less operative as a regulator of pleasure. Alcohol consumption - an activity associated with pleasant hedonic experiences (at least in current smoking data) - did predict eating frequency. However, the nature of this relationship - wherein periods of more recurrent drinking were followed by periods of more recurrent eating - suggests that it may have more to do with physiological regulation than anything affective. The assessed divisions of periodicity make it unlikely that the alcohol-eating relationship reflects approach priming or general disinhibition of consumption behaviour by alcohol. Such a trend would be more likely to manifest as within-period covariation in the design that was implemented – as it did in periodic tests of an alcohol-smoking relationship. The predictability of consumption frequency by prior drinking is more likely reflective of attempts to counter a biological imbalance (replace nutrients, electrolytes, and water) caused by heavy drinking sessions.

8.3.3 Smoking and hedonic experience: periodic further to episodic regulation

Smoking may affect periodic hedonic experiences such that negative events are perceived as less unpleasant during periods when more smoking episodes occur. Furthermore, periods of high positive hedonic salience (when experiences are rated as most pleasant) are followed by less frequent smoking. This effect did not appear to result from inhibitory effects of over-consumption of cigarettes or alcohol in the preceding period: it emerged over and above the influence of prior smoking frequency and alcohol consumption. The observed lagged relationship suggests that smoking might be used to regulate hedonic experience over time, such that periods perceived as less intensely pleasurable might be counteracted subsequently by a period of heavier smoking. Framed another way, periods of intense pleasure might

temporarily sate hedonic drive and motivate a reduction in subsequent smoking. Additionally, analyses of data from the quasi-interventional data indicated that periods of more frequent smoking were followed by ratings of greater happiness at the point of periodic recall.

Taken together, hedonic experiences in relation to smoking frequency appear somewhat consonant with effects observed in episodic analyses. These earlier analyses demonstrated that smoking cues/anticipation may be associated with increases in happiness, and that enhancement of hedonic tone may show a cumulative trend over the course of daily smoking. Present findings for periodic trends indicate reactivity between smoking behaviour and hedonic experiences that is supportive of an interpretation of episodic smoking in terms of mood regulation. Smoking behaviour tends to increase following periods of low hedonic value, and increased intake tends to enhance subsequent happiness (especially for those with a history of more severe smoking). Furthermore, smoking may help to limit the perceived anhedonic value of negative experiences occurring at temporal propinquity.

The relationship upon which the latter interpretation is based might also indicate that sampled smokers tended to smoke at times when their hedonic experiences were not markedly negative. Such behaviour might reflect an occasional pattern of smoking, wherein typical occasions are likely to be times of leisure (e.g., Shiffman *et al.*, 1994; Davies, Willner, & Morgan, 2000) when anhedonic experiences may be less pronounced. However, the fact that the relationship between smoking frequency and unpleasantness of experience was not moderated by dependence variability may undermine this interpretation. Indeed, conscientiousness – a marker of smoker status (see Chapter 7) – attenuated the observed relationship in a way that suggests this reactivity might serve partly to motivate smoking development/maintenance. Given the observed moderation, an interpretation in

terms of smoking to regulate hedonic value of concurrent negative experiences seems more probable – with less conscientious individuals more prone to using smoking as a modifier of experiential perceptions (such individuals may be less prepared for - and less direct/disciplined in their coping with - negative situations; Medvedova & Kovac, 2004).

8.4 Next chapter

Chapter 9 - the final results chapter – considers motivational differences between normal and abstinence smoking. Differences are investigated in both episodic and periodic experiences, so as to address important issues. For example, are lapses primed by the same hedonic elevation as normal smoking? Does current hedonic mood deteriorate after abstinence periods? These questions follow from models derived in preceding chapters, but it may be that different models operate during abstinence. Comparison of normal versus deprivation smoking in everyday situations has potential implications for better understanding relapse processes in cessation. Analyses in this chapter also facilitated understanding of trait factors that may moderate likelihood of lapsing and/or lapse frequency.

Chapter 9. Changes associated with abstinence

The preceding chapters (5, 6, and 8) have examined smoking-related experiences hierarchically in terms of both event-contingent and periodic processes. Analyses in these chapters derived from data collected during periods of everyday smoking - wherein participants were encouraged to behave as they would 'normally' (i.e., if they were not participating in a study). The present chapter examined data from the quasi-interventional diary study in order to compare processes identified in normal smoking with processes evident during abstinence.

Central findings from preceding chapters indicate that hedonic moderation is associated with everyday smoking behaviour - but not with desire to smoke - and that desire to smoke is not related to smoking frequency (although events are associated with acute changes in desire). These findings are somewhat incongruent with previous research (e.g., Parrott, 1998; although the literature is not consistent; Kassel *et al.*, 2003) and this disparity may reflect differences in methodological approach. An important divergence in this regard is that data in the present research came from ambulatory monitoring of normal smoking whereas previous studies have generally examined experiences in a state of deprivation (and typically in artificial environments)(Gilbert, 1995).

As the present chapter focuses on deprivation reports it might be expected that findings will be more reflective of research suggesting that smoking is related to stress, anger, and negative reinforcement. Similarly, desire to smoke may be more likely to demonstrate association with lapse episodes/frequency than with smoking during periods without obstruction/deprivation (Tiffany, 1995). Earlier findings indicated that these predictions might be mutually supportive, as desire – although not related to significant episodic changes in hedonic tone or energetic arousal – showed a positive association with tense arousal and anger/frustration. On the

other hand, current support for hedonic mechanics of motivation suggests that dimensional happiness-depression (and related pleasantness/unpleasantness of experience) is likely to be implicated in abstinence too. The finding in Chapter 8 that increased smoking frequency leads to increased interval happiness would suggest that encouraged abstinence periods (when smoking rate should be lower) will be marked by decreased happiness. It is less clear what the implications of hedonic smoking cueing (in normal behaviour) might be for smoking during encouraged abstinence: lapses might be more likely to occur when an individual is feeling happy, but they might also be cued by negative hedonic shifts – with smoking undertaken in an attempt to regain associated pleasure (e.g., Gilbert & Warburton, 2003). Again, other mood dimensions (such as tense arousal) might become operative too.

It is important to see whether episodic correlates of lapses are the same as those found in normal smoking, or whether certain factors become relatively more prominent in smoking during deprivation. If there are no differences between normal and abstinence episodes, findings for normal smoking cues and effects - especially those that were shown to be more specific to smoking (not general consumption) - may be extrapolated to cessation and understanding of relapse. Such an extrapolation would suggest that smoking-specific associations/processes may become cues/motivations for reinstatement during abstinence. Similarly, periodic comparisons facilitate understanding of consistencies and differences between everyday experiences during smoking and everyday experiences during abstinence. Such an understanding has implications for coping strategies in relapse prevention. Furthermore, this chapter maintained the hierarchical approach to understanding behaviour that has characterised the present research – facilitating sophisticated sampling of abstinence experiences (Shiffman *et al.*, 1997a). Available evidence indicates that the acute effects of abstinence should not vary greatly according to dependence level: inexperienced light smokers report the same

subjective effects of deprivation as heavier smokers (Riedel *et al.*, 2003). It may be that dependence-related individual differences in these effects emerge later in abstinence (after 1-2 weeks; Piasecki *et al.*, 1998).

9.1 Investigatory Perspectives

9.1.1 Periodic abstinence experiences and moderation

Mood and desire at interval

Modelling of fixed-interval data examined whether mood and desire (at interval) covaried with abstinence period (0 = present/preceding period of normal smoking, 1 = present/preceding period of encouraged abstinence). These relationships were initially analysed in a series of within-person (level 1) models, and subsequently extended at level 2 to examine person-level moderators as in previous chapters.

Other periodic experiences

Similar models were constructed to examine periodic changes during abstinence. The fixed-interval diary assessment was designed to record other experiences that have been implicated in motivation to smoke; these variables all reflect phenomena recalled over the duration of the preceding period/since the previous fixed assessment was completed. The following variables were entered into the level 1 abstinence model at this stage of analysis: Perceived Stress Scale score, craving (composite of frequency, intensity, and duration; $\alpha = .77$), passive smoke exposure (separate scores for frequency, intensity, and duration), distractibility, pleasantness/unpleasantness of events, and caffeine/alcohol consumption. Significant relationships were subsequently tested for moderation by making the model conditional at level 2.

Smoking frequency ('lapses')

These analyses replicated the previous chapter's modelling of periodic covariation with smoking frequency (and relevant moderation), but utilising data from the abstinence periods only (64 level-1 units). In this way, these analyses sought to elucidate potential predictors/effects of 'lapsing' (the frequency of smoking during 24 hours of encouraged abstinence). Lapse frequency was modelled as a main effect of person level variability, and significant slopes for lapse frequency were also modelled as an outcome of person level variability.

9.1.2 Episodic 'lapse' experiences and moderation

Experiences associated with lapse versus normal smoking events

Modelling of episodic (level 1) variables examined covariation between episode status (0 = normal smoking, 1 = smoking during abstinence period) and other episodic variability. In this way they identified potentially telling differences between normal smoking and smoking during deprivation. These analyses were broken down into three conceptual components that might be considered to be in sequential order (possibly suggestive of serial causation): contextual cues, internal cues (pre-smoking mood and desire), and consumption-related lapse effects (intake variability and post-smoking mood and desire). Episodic variables investigated in these models were those examined in previous analyses of smoking events. All significant slopes were made conditional at level 2 to identify relevant moderation.

Direct moderators of lapse occurrence

A final stage of episodic modelling examined episode status as a main outcome of person-level variability. Analysis at this stage determined individual differences in the likelihood of lapsing relative to each individual's normal smoking rate. In this way these analyses gave an indication of trait markers of unreadiness to abstain that is not proportional to physical dependence/general smoking intensity. Thus,

these analyses potentially tap information that may not be evident in preceding models of lapse frequency moderation.

9.2 Results

9.2.1 Periodic changes during abstinence and moderation

Mood and desire at interval

Table 9.1 shows all significant relationships between preceding period (0 = normal, 1 = abstinence) and current state (mood and desire at time of interval-contingent report). Person-level moderators are also shown in this table.

Table 9.1

Abstinence periods and subsequent internal state: Relationships and moderation

	γ_{10}	γ_{11}	*t*	*p*
Hedonic Tone	-.68		-3.72	.001
Tense Arousal	.85		4.67	<.001
Anger/Frustration	.47		3.06	.005
QSU Baseline Craving		.29	2.50	.02
Desire to smoke	1.10		5.11	<.001
BAS Drive		-.21	-2.05	.05

Note. Italicised variables are level-1 covariates with abstinence period (0 = normal smoking, 1 = abstinence period). Moderators of level-1 covariation are shown indented without italics, immediately below relevant slopes. Mean unstandardised coefficients are in the columns labelled γ10 and γ11

Smokers tended to report greater tense arousal and anger at intervals following abstinence periods as compared with at intervals subsequent to normal smoking.

Taking the relationship between tense arousal and period type as an example, the second row of Table 9.1 shows that the mean slope between tense arousal and abstinence was positive and significantly different from 0 (γ_{10}= .85, t= 4.67, p <.001). Smokers also reported decreased hedonic tone at intervals following abstinence versus normal smoking periods. Interval reports of energetic arousal did not differ between conditions. Participant records further indicated that - relative to experienced intensity at the end of normal smoking periods – urge to smoke was stronger after periods of encouraged abstinence.

In terms of moderation, smokers with higher levels of generalised craving had a stronger tendency to report frustration following abstinence versus normal periods. Also, BAS sensitivity attenuated desire reactivity: smokers with greater approach impetus were less likely to report elevated desire following periods of encouraged abstinence.

Other smoking-related periodic experiences

Table 9.2 shows all significant relationships between period type (0 = normal, 1 = abstinence) and concurrent experiences. Moderators of identified relationships are also presented in this table.

Table 9.2

Abstinence periods and concurrent experiences: Relationships and moderation

	γ_{10}	γ_{11}	*t*	*p*
Craving	3.84		5.19	<.001
RTQ Dependence Score		3.03	2.69	.01
Passive Smoke Intensity	.94		2.35	.03

Note. Italicised variables are level-1 covariates with abstinence period (0 = normal smoking, 1 = abstinence period). Moderators of level-1 covariation are shown indented without italics, immediately below relevant slopes. Mean unstandardised coefficients are in the columns labelled γ10 and γ11

Participant reports indicated that abstinence periods were marked by increased craving experiences (a reflection of the frequency, intensity, and duration of urges) relative to periods of normal smoking. It was also found that individuals tended to report a stronger awareness of other people's smoke over periods of encouraged abstinence.

In terms of moderation, craving reactivity to attempted abstinence was stronger for more physically dependent smokers. These individuals experienced greater craving during abstinence (relative to their normal experiences) than their less dependent counterparts.

Lapse frequency and related periodic experiences

Analyses of smoking frequency during abstinence periods indicated that lapse count did not covary with other periodic experiences except for subsequent happiness (γ_{10} =.25, t = 2.05, p =.05). Smoking more during abstinence periods tended to improve hedonic mood (as assessed at next interval). Cross-lagged analyses

indicated that happiness did not predict subsequent smoking frequency during abstinence.

Lapse frequency was moderated by dependence-related variability. Individuals with a history of heavier smoking tended to smoke more often during the abstinence period (γ_{01} =.09, t = 4.18, p <.001), as compared with those who had maintained a career of less-intensive smoking. Similarly, more 'lapses' were evident for those with greater physical dependence (γ_{01} = .11, t = 3.14, p = .004) and those who perceived themselves to be more addicted (γ_{01} = .30, t = 3.13, p = .004). However, these moderating effects were not independent of each other or of variability representing past high-frequency smoking – only heaviest smoking rate remained a significant moderator when any two of the three identified moderators were modelled together.

9.2.1 Episodic changes during abstinence and moderation

Internal state when smoking cued

Table 9.3 shows all significant relationships between lapse status (0 = normal episode, 1 = lapse episode) and pre-smoking changes in internal state (mood and desire). Moderators of identified relationships are also presented in this table.

Table 9.3

Lapse episodes and internal cues (changes from baseline to pre-smoking): Relationships and moderation

	γ_{10}	γ_{11}	*t*	*p*
Tense Arousal	.40		4.00	.001
Anger/Frustration	.51		3.89	.001
Agreeableness		.07	3.71	.001
Desire to smoke	.73		5.87	<.001
Heaviest Smoking Rate		.03	2.23	.04

Note. Italicised variables are level-1 pre-smoking change-scores that covary with lapse status (0 = normal smoking episode, 1 = episode during abstinence period). Moderators of level-1 covariation are shown indented without italics, immediately below relevant slopes.

Mean unstandardised coefficients are in the columns labelled γ10 and γ11

Tense arousal and anger tended to be greater immediately before lapse episodes, as compared with mood cueing non-lapse episodes. Lapse status was not associated with pre-smoking hedonic tone or energetic arousal. With regard to craving, lapse episodes were cued in a stronger urge state: pre-smoking elevation of desire was reportedly greater during attempted abstinence than normal smoking.

In terms of moderation, more agreeable individuals demonstrated more marked differences in frustration between lapse and non-lapse episodes. These individuals may be less likely to experience anger under normal conditions, such that deprivation-prompted frustration is a particularly salient change for them. No other moderating relationships were uncovered for mood-lapse covariation. Smokers with a history of heavier consumption experienced stronger urge before lapse episodes (relative to normal episodes) than those who had smoked at a lower rate.

Activities and external context when smoking cued

Table 9.4 shows all significant relationships between lapse status and pre-smoking context. Moderators of identified relationships are also presented in this table.

Table 9.4

Lapse episodes and situational context: Relationships and moderation

	γ_{10}	γ_{11}	*t*	*p*
Post-Meal	-.67		-2.90	.008
QSU Baseline Craving		-.98	-3.83	.001
Post-Sex	2.01		3.31	.003
QSU Baseline Craving		.65	6.09	<.001
Drinking Tea/Coffee	.71		2.07	.05

Note. Italicised variables are level-1 contextual variables that covary with lapse status (0 = normal smoking episode, 1 = episode during abstinence period). Moderators of level-1 covariation are shown indented without italics, immediately below relevant slopes.

Mean unstandardised coefficients are in the columns labelled γ10 and γ11

Compared with normal episodes, lapse episodes were less likely to occur after eating, and more likely to occur after sex and when drinking tea or coffee. No other activity states covaried with lapse events and lapse status was not associated with company or location variables.

In terms of moderation, smokers with higher levels of generalised craving had a stronger tendency to lapse after sex; these same individuals were less likely to lapse after food consumption.

Consumption-related lapse effects

Table 9.5 shows all significant relationships between lapse status and consummatory (pre- to post-smoking) effects. Moderators of identified relationships are also presented in this table.

Table 9.5

Lapse episodes and consumption effects (pre- to post-smoking changes/intake): Relationships and moderation

	γ_{10}	γ_{11}	*t*	*p*
Tense Arousal	-.65		-2.81	.009
Energetic Arousal	-.34		-3.09	.005
Smoke Inhalation	.21		2.81	.009
BAS Reward Responsiveness		.04	2.13	.04

Note. Italicised variables are level-1 consumption-related change-scores and intake measures that covary with lapse status (0 = normal smoking episode, 1 = episode during abstinence period). Moderators of level-1 covariation are shown indented without italics, immediately below relevant slopes.
Mean unstandardised coefficients are in the columns labelled γ10 and γ11

Smokers experienced more stress reduction from smoking events during abstinence, as compared with normal smoking. However, they also experienced greater sluggishness following lapse episodes. No lapse relationships were found for other pre- to post-smoking mood changes or satiation of desire. A further finding was that smokers tended to inhale more deeply during lapse episodes, relative to their normal intake.

In terms of moderation, those who are more reward-responsive reported a stronger tendency to inhale deeply during lapse versus non-lapse episodes - suggesting that

they particularly savoured such (rewarding) events when their occurrence was limited. No other moderating relationships emerged.

Direct moderators of lapse occurrence

The only significant moderator of lapse occurrence was perceived addiction (γ_{01} = .26, t = 2.71, p = .01) - a marker of readiness to change. Individuals who saw themselves as dependent on smoking were more likely to smoke during the encouraged abstinence period, as compared with those who reported lower perceived dependence.

9.3 Discussion

With regard to the principal focus of this chapter, there were clear shifts in mood and other smoking-related experiences during deprivation (as compared with normal behaviour). Figure 9.1 shows the derived hierarchical model of periodic changes associated with abstinence. Figure 9.2 shows the derived hierarchical model of experiences particularly associated with lapse episodes as compared with normal smoking episodes. These models are discussed in detail in this section of the chapter, as they relate to findings in both the present research and previous literature. Sequentially, sub-sections consider deprivation-related changes in periodic experiences, deprivation-related changes in episodic experiences, and the predictability of lapsing.

Figure 9.1

Model of periodic changes during deprivation

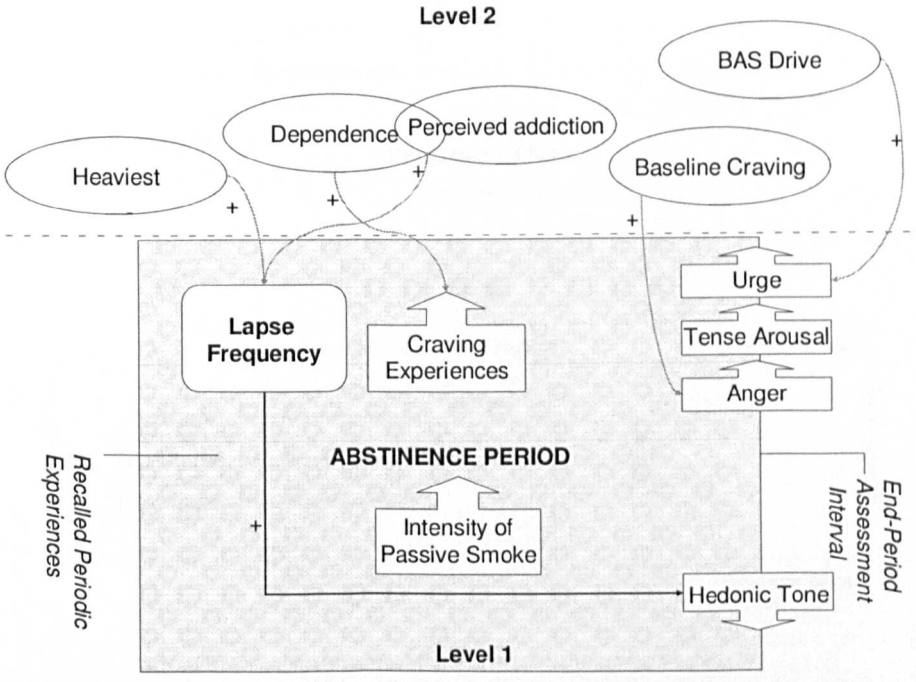


Figure 9.1 represents periodic changes at Level 1 of the model (below the dividing line) and stable moderators of these relationships at Level 2 (above the dividing line). Boxes with vertical arrows show changes during deprivation; the direction of these arrows indicates whether the specified variable increased or decreased during the abstinence period. For example, craving during abstinence periods was shown to increase, and current happiness (reported towards the end of abstinence periods) was shown to decrease. The exceptional variable in the model shown is lapse frequency: this was not examined as a change between normal and abstinence periods (i.e., as a covariate of period type). Relationships pertaining to this variable are derived from the abstinence data alone (smoking during normal periods was not defined as lapsing). The connection between lapse frequency and hedonic tone was shown to be temporally unidirectional in cross-lagged analyses, and this is represented graphically. The plus sign proximal to this connection shows that increases in lapse frequency are followed by increases in subsequent hedonic tone. Similarly, the direction of moderating relationships is shown by the symbols adjacent to connections from level 2 to level 1 variables. For example, the increase in anger during abstinence is greater for individuals who reported stronger craving at baseline.

Figure 9.2

Model of episodic changes during deprivation

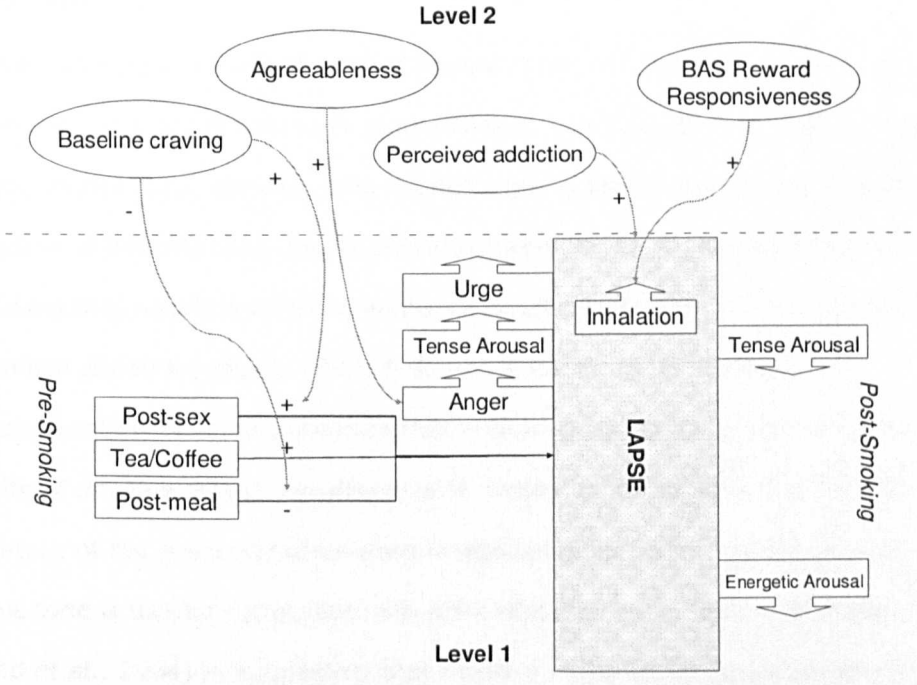


Figure 9.2 represents episodic changes at Level 1 of the model and stable moderators at Level 2. At level 1, the shaded box represents the duration of lapse smoking; time is loosely conceptualised as advancing from left to right in this figure. Thus, variables shown to the left of the box depict pre-smoking contextual differences and variables to the right reflect post-smoking contextual differences. For example, lapse episodes were more likely to occur after sex (relative to normal episodes), and this is depicted by the positive variable-lapse connection. Similarly, lapse episodes were preceded by stronger urges (relative to normal episodes) and this is represented by the box-arrow attached to the graphical lapse representation – note the upward arrow indicative of increased urge in connection with lapse events. As in the previous figure, the direction of moderating relationships is shown by the symbols adjacent to connections from level 2 to level 1 variables. For example, the increase in inhalation during lapse smoking is attenuated for individuals who are higher in BAS reward sensitivity.

9.3.1 Periodic experiences during deprivation

Hedonic affectivity

Previous chapters have indicated that hedonic tone and (perhaps epiphenomenally) energetic arousal are the primary dimensions of mood associated with everyday smoking motivations. Hedonic tone *is* implicated in abstinence, and the relative depression of hedonic tone during periods of abstinence is consistent with theories suggesting that negative affect in withdrawal reflects the effects of a compensatory mechanism (Koob & LeMoal, 1997; Solomon & Corbit, 1974). Such a conceptualisation fits data indicating that withdrawal symptoms resemble the opposite of positive effects associated with smoking (Eissenberg, 2004a; 2004b). The nature of the presently uncovered relationship between period type and hedonic tone is further consonant with prior research (e.g., Wills & Shiffman, 1985; Breland *et al.*, 2004) in suggesting that mood is restored to normal levels after normal consumption is resumed. This is because modelling of relationships between period type and mood essentially tested the fit of an inverted-U function to mood at six fixed intervals.

Preceding chapters have found positive-incentive effects of smoking on hedonic mood. In light of this, the current results could be interpreted as indicative that smokers' general happiness may decline without the normal hedonic boosts associated with smoking episodes. In support of this, smoking more during abstinence periods (repeated lapses) led to relatively greater happiness at the next assessment interval, apparently protecting against the general dysphoria associated with abstinence. However, concomitant increases in general stress and anger support the notion that mood mechanisms involved in abstinence may also be somewhat independent of those implicated in maintenance (Kassel *et al.*, 2003) - different dimensions could play a role in withdrawal/undermining acute attempts to abstain

Stress and annoyance

The difference in general anxiety between normal and abstinence periods provides the first evidence in the present research linking smoking to purported calming effects (Ikard *et al.*, 1969). Stress alleviation appears to emerge as an important smoking-motivational factor during abstinence attempts, and this is congruent with Parrott and Garnham's (1998) finding that smoking only had relaxing effects for deprived (versus non-deprived) smokers. Everyday smoking may become regulated such that withdrawal-related tension does not emerge as an episodic cue. Tense arousal is generally elevated during abstinence, suggesting that BIS-related affectivity responds to encouraged deprivation as a threat state (with smoking as an act of avoidance). Indeed, encouraged deprivation may present a situation where multiple competing goals are active (e.g., approaching smoking or avoiding 'withdrawal' versus avoiding perceived failure at the challenge of abstaining). The involvement of BIS-related affect in such goal-conflict scenarios is especially consistent with recent clarifications of RST (Gray & McNaughton, 2000; Corr, 2004).

Anger/frustration is more pronounced during deprivation and this could represent various mechanisms: anger is implicated in fight-flight responses to unconditioned withdrawal (Gray, 1994); as being closely related to anxiety and BIS sensitivity (Watson *et al.*, 1999); and as reflecting BAS sensitivity to frustrative nonreward (Harmon-Jones & Sigelman, 2001). The concept of frustrative nonreward may indeed represent complex interactions of the BIS and BAS (Carver, 2001). This experience was not moderated by individual variability, and appeared not to be specifically changed by lapse smoking – perhaps reflecting persistent frustration when rewards do not meet (deprivation-enhanced) expectations (Corr, 2002). In keeping with this argument, abstinence increases in anger were more pronounced for those who had greater baseline craving (an assessment of smoking

expectations). More generally, this finding bolsters support in the current research for association between frustrative mood and desire to smoke.

Considered together, the present mood-related results fully replicate findings from studies by Gilbert and colleagues (Gibert *et al.*, 1998; Gilbert *et al.*, 2002). These investigations found that anger, tension and depression increased significantly during abstinence. Interestingly, these investigations examined abstinence over 31 days, and found that initially observed mood disturbances did not resolve over this time. Applied to the present findings, this indicates that experiences captured in the encouraged abstinence period are valid representations of processes occurring in cessation – and that observed changes would be unlikely to return to pre-abstinence levels if normal smoking was not reinstated. Furthermore, previous findings for the temporal persistence of observed mood changes suggest that they are not simply manifestations of short-term physical withdrawal (Hughes *et al.*, 1990). Sustained mood disturbance points to the importance of smoking as a regulator of affective experiences.

Craving and smoking-related perceptions

As expected, desire/cravings to smoke appeared more pronounced during periods of attempted abstinence. The current results are consistent with theoretical suggestions that craving becomes a more conscious/non-automatic process when normal smoking patterns are disrupted (Tiffany, 1990). Such a shift would account for reported heightened perceptions of craving(s). The implications of these findings should not be over-emphasised however, as - within the current quasi-experimental paradigm – items relating to craving during abstinence may be particularly prone to the influence of perceived demand characteristics. The prediction that craving and smoking frequency might show greater association during deprivation was not supported in the present analyses. This at least is consistent with the majority of empirical research (Drummond, 2001), which has found that craving is not a

necessary pre-condition of relapse. It might be that the relationship between craving and smoking/lapsing is somewhat precipitous, such that periodic assessments are not well suited to capturing the association – episodic analyses in the present research show strong contemporaneous covariation. The relative elevation of current urge reports during abstinence was reduced for individuals with high BAS drive. This is consistent with other findings in the present research that suggest craving may be particularly context-insensitive and persistent in those with high levels of the BAS drive trait. BAS drive reflects the strength of approach impetus (Carver & White, 1994), and is largely independent of affective value and other potential modifiers of the approach goal value (Johnson *et al.*, 2003). Given this, it seems reasonable that individuals who have high levels of the drive sub-trait are relatively constant in their urge to smoke: compared to low-drive individuals, their desire is not as reactive to deprivation - and this may partly reflect the theorised insensitivity to affective influences represented by the BAS drive trait (the clearest change between normal and deprivation states was an increase in negative mood). Since urge reports were not related to lapse frequency, it is not possible to conclude that individuals with high BAS drive are more able to resist lapsing during deprivation (by virtue of their relatively limited urge-increase in this condition). Indeed, to the extent that BAS drive moderates craving reactivity, those high in drive may be more susceptible in the longer-term: their desire to smoke might persist at the same levels long after cessation. In contrast, other people (lower in drive) may experience a sharp decline in desire after a short period of abstinence/withdrawal (just as they experienced a more pronounced response to its onset).

Reported perceptions of environmental smoke indicated a shift in sensory sensitivity between normal and reduced smoking states. As might be expected, the frequency and duration of exposure to others' smoke was not greater during periods of abstinence (indeed, it might have been predicted that subjects

attempting to abstain would avoid smoky environments/other smokers such that a negative association would emerge). Against this, the relationship between perceived intensity of passive smoke and abstinence suggests that smoking-related stimuli acquire greater saliency during deprivation, such that passive smoke (though encountered as often as during normal smoking, and over similar durations) becomes more noticeable.

9.3.2 Smoking episodes during deprivation

Internal cues associated with deprivation smoking

As in the analyses of fixed-intervals, anxiety and anger emerge as more important correlates of smoking motivation during abstinence. Here, these dimensions are directly implicated in the cueing of lapse episodes – further to findings for more general increases in stress and irritability during abstinence. However, hedonic tone and energetic arousal did not differ between lapse and normal smoking episodes, suggesting that pre-smoking happiness and alertness are consistently elevated, on average, across episodes. Lapses appear to be cued in incentive states similar to non-lapse smoking events - despite the background of impaired mood during deprivation (increased periodic and episodic anger/ tense arousal, decreased periodic hedonic tone). There is evidence therefore for the lapse-precipitating implications of earlier incentive-sensitisation findings: the prediction being that extreme experiences of happiness and/or energetic arousal could cue relapse to smoking, both short- and long-term. Periodic findings assist interpretation of episodic findings: anger and tense arousal are generally increased by deprivation (perhaps reflecting unconditioned withdrawal effects), but pre-lapse reports of hedonic tone and energetic arousal evince that incentive motivation remains an acute anticipatory cue for smoking. The hedonic component of pre-lapse mood is likely to be particularly strong, as it emerges against a background of depressed hedonic tone (at the periodic level). Incentive-prompted lapsing may be a clearer

trend after initial unconditioned withdrawal experiences have subsided (i.e., after the period assessed in this study).

Pre-smoking craving was greater in lapse episodes, relative to normal episodes. Taken together with pre-lapse anger and tension, this finding appears to support the indications of previous analyses (chapter 5) that urge to smoke is more closely related to certain negative affective experiences and that this cluster of phenomena (frustration-stress-desire) might be more pronounced during deprivation. Lapse-related urge was most elevated over normal smoking urge for those with a history of more severe smoking – consistent with evidence that symptom intensity correlates with an individual's habitual intake (Hatsukami, Hughes, & Pickens, 1985a; 1985b). Anger experiences were independently moderated by agreeableness in the current results. Trait agreeableness is not theorised to generate affectivity directly, but is likely to reflect a behavioural style that is marked by particular moods. Zillig and colleagues (2002) analysed the affective processes reflected by the Big 5 personality traits and found that the strongest affective component of agreeableness was the sub-trait of tender-mindedness. It can be inferred from this that more compliant individuals are less likely to get angry with situations generally, such that abstinence-related frustration is relatively more pronounced in these people.

Contextual cues associated with deprivation smoking

Lapse episodes recorded in the present study did not differ from other smoking episodes in terms of where the subject was, and whether they were alone or with others (smokers or non-smokers). Lapse episodes also occurred across a similar range of activities, but they were particularly associated with drinking tea or coffee, and being in a state subsequent to sexual activity. These conditions have been defined as rewarding and possessing positive hedonic value (Hoebel, 1988, Bozarth, 1994). Consequently, the observed relationships with lapse likelihood

might perhaps be interpreted as reflecting cross-reward sensitisation or priming (pleasure gained from these activity states could represent a strong cue for smoking since it has been established that hedonic elevation is associated with smoking). The related, mutually-complimentary behaviours (sex, smoking, drinking tea or coffee) may have developed specific behavioural contingencies such that doing one produces disinhibitory impulses to do another. These findings provide the first support in the present research for literature documenting behavioural associations between tea/coffee consumption and smoking (Marshall *et al.*, 1980; Rose, 1986).

Interestingly, another activity-state related to reward (e.g., Shinohara *et al.*, 2004) – being in a post-consumption state – demonstrated an independent opposite association with lapse likelihood. This might imply that eating could be experienced as a substitute activity for smoking - consistent with the notion that abstinence-related negative affect and appetite increase are partly mediated by common mechanisms (Spring *et al.*, 1991; Gilbert, 1995) - such that the temptation to lapse is temporarily suspended following food consumption. Taken with evidence for the appetite-suppressing effects of nicotine (Arcavi *et al.*, 1994) and increased appetite during abstinence (Gilbert *et al.*, 2002), this could help to explain trends towards snacking and weight gain following smoking cessation (Williamson *et al.*, 1991). That the negative relationship between lapsing and being in a post-consumption state was stronger for individuals with higher generalised craving further suggests that desire to perform one behaviour might be sated by performing a substitute behaviour.

The identified potential lapse cues are further to those that did not differ between smoking events (lapse versus non-lapse), but do differ between smoking events and other consumption events (chapter 8). Situations that are particularly associated with smoking behaviour/being a smoker might also become triggers for

relapse - without being relatively more prominent in lapse events. For example, alcohol consumption accompanied 13% of lapse episodes and 10% of normal smoking episodes; alcohol consumption was not significantly more associated with either event-type, but rather was a prevalent cue for both. This conclusion was supported by comparisons with eating behaviour (as a control consumption experience), which found that normal smoking events (and by extension, lapse smoking events) were particularly associated with drinking alcohol – alcohol consumption only accompanied 1% of eating events. Given the proportional frequency that smoking occurs with drinking of alcohol, and that this proportion is carried over into lapsing, it is evident that these behaviours are linked and that alcohol could be a potent episodic trigger for smoking (although periodic alcohol consumption and lapse frequency were not found to be related).

Consumption effects of deprivation smoking

Relative to normal smoking, lapse events were shown to have greater direct (consumption-related) effects on mood. More specifically, the act of smoking attenuated anxiety and concurrently decreased alertness. The finding for stress-relieving effects of smoking is consonant with previous laboratory research (e.g., West, 1993; Pomerleau & Pomerleau, 1991), but only emerged during abstinence when pre-smoking stress was elevated. Studies using stress induction have demonstrated some of the biggest effects for anxiolytic smoking (Parrott, 1998). The finding that smoking during abstinence is associated with subsequent tiredness is not consistent with evidence in the literature that pre to post-smoking changes after deprivation should show particular elevation of alertness (Church, 1989; Perkins *et al.*, 1992). Some studies have found opposite effects – decreases in arousal (Newhouse *et al.*, 1990; Perkins *et al.*, 1993) – but these studies used large nicotine doses that may have pushed beyond the peak of the inverted-U curve for arousal (Parrott, 1992; Eysenck, 1973).

Finally, the current finding that smoke intake was greater in lapse versus normal smoking episodes appears consistent with the urgency and reduced frequency of episodes during encouraged abstinence. The trend in lapse self-report towards deeper physical inhalation of smoke corroborates the notion that experiences in the quasi-intervention study reflect deprivation. Ahijeyth and colleagues (2004) have previously observed that smokers attempt to compensate for deprivation by increasing inhalation. Individuals with greater BAS reward sensitivity had a stronger tendency to inhale more deeply during lapse episodes. These individuals may be attempting to counteract the reduced frequency of smoking. It has already been observed that hedonic incentive effects are reduced in individuals with greater reward responsiveness: during deprivation, when hedonic tone is generally depressed, these individuals may be more sensitive to the limited hedonic effects they receive from smoking, and so try to compensate by modifying their physical intake (deeper inhalation in the few episodes that do occur).

9.3.3 Lapse predictability

Lapse Frequency

As expected, the frequency of lapsing during deprivation tends to be greater for those who demonstrate greater dependence (Killen *et al.*, 1992; Edwards, 1986). Taken with the lack of individual variability in other deprivation experiences, this would suggest that withdrawal/abstinence has a generalised effect (relatively insensitive to personality), and that dependence moderates response to this experience. That is, those who have more experience of withdrawal seem to become more intolerant to it (perhaps reflecting more learning that smoking is the best method of escaping; Baker et al., 2004a), such that they smoke more frequently in response. However, due to the voluntary (but not self-directed) nature of deprivation, it is difficult to tell how informative 'lapse' frequency might be

(whereas other experiences early in deprivation have been shown to have long-term implications; Gilbert et al., 1998; Killen & Fortmann, 1997).

Markedly, smoking frequency during abstinence was seemingly insensitive to other periodic variability – lapses might best be understood in terms of their episodic context and correlates, as momentary mechanisms (Brownell *et al.*, 1986). However, an episodic focus on lapsing may implicitly construe such events as unpredictable reactions to immediate stimuli (Shiffman, 1989). By examining more general temporal processes and predictive moderation of responses by individual variability, the present approach at least allowed for understanding of behaviour beyond contemporaneous associations (a basic stimulus-response approach). Future research might apply this approach to long-term cessation attempts and find that lapses in this context (with motivated quitters rather than volunteer short-term abstainers) are systematically related to periodic experiences and higher-level dispositions that are not smoker-specific (and thus somewhat circular in their application). On the other hand, it might well be that lapses are best understood at the episodic level (e.g., Shiffman & Waters, 2004; Shiffman *et al.*, 1996), as acute processes in reaction to contextual changes, such that findings in the present chapter are indicative of true withdrawal mechanisms and perhaps even longer-term relapse. The fact that lapses can occur long after cessation (Somoza *et al.*, 1995) may support the notion that suddenly arising stimuli combinations can trigger smoking.

The present chapter has shown that, relative to normal smoking events, lapses are particularly associated with increased stress, anger, dysphoria, and specific activity states. The relative depression of hedonic mood captured in lapse episodes (as compared with normal smoking) could be a particularly significant experience, as the only recorded effect of lapse frequency was elevation of subsequent happiness. Hedonic motivation has potential as a common link between episodic and periodic

lapse experiences: although pre-smoking hedonic elevation is attenuated in lapse events, effects of smoking still seemed sufficient to boost subsequent mood (as assessed at interval).

Lapse events

The likelihood of lapsing over an acute period of encouraged abstinence was largely not predicted by the person-level variables under test. Tellingly, those who believed themselves to be most dependent on smoking were most likely to 'lapse'. This may represent a self-awareness of inability to withstand short-term withdrawal effects, but is also likely to reflect an attitudinal bias that would undermine any attempt to abstain for the purposes of this study. This latter notion is not completely supported however: lapse occurrence was not predicted by differences in desire to stop smoking or confidence in ability to stop smoking. These variables should have tapped into the kind of attitudinal bias under discussion (unwillingness to abstain, or lack of belief in readiness to abstain), but it could be that subjects with such a bias would be more likely to attribute their unwillingness to change to addiction (beyond their control) than to more self-implicating markers – and score associated scales accordingly. The lack of association between episodic lapse incidence and dependence score/heaviest rate points to different implications of episodic moderation as compared with periodic moderation of lapse frequency (discussed previously). Lapse status as an outcome reflects lapse frequency in relation to normal episodic frequency. Therefore, markers of dependence are unlikely to moderate this outcome: heavier smokers may smoke more during the abstinence period, but they also tend to smoke more during other periods. The observed moderation by perceived addiction thus represents a propensity to relapse that is out of proportion with normal smoking rate. These individuals may have been less able to endure acute withdrawal effects due to some unmeasured trait(s) reflected in their own perceived smoking compulsion. But Perceived addiction may rather reflect a lack of self-belief or willingness to attempt/test abstinence ability.

Chapter 10. General Discussion

The present thesis focused on the motivational relationship between mood and smoking. Uniquely, this relationship was investigated in an interactive framework examining: (1) its association with natural contextual variability; and (2) its moderation by theoretically relevant individual differences (principally BIS-BAS). Comparisons of everyday smoking behaviour with an appetitive behaviour facilitated preliminary understanding of how the motivational model for smoking contrasts with a parallel model for natural reward-consumption (eating behaviour). Similarly, assessment of experiences during restricted smoking behaviour identified important deprivation-conditional modification of motivational states.

This chapter discusses the main findings of the research and considers their implications for models of mood and personality, further to insights gained about smoking motivation.

10.1 Central questions answered

Discussion in this section is structured around the central questions posed in the first chapter:

1) Are everyday smoking episodes associated with mood alteration, and is this relationship influenced by situation and/or personality?

2) Are there more distal/gradual processes (over the course of a day) that influence smoking rate and/or the desire to smoke?

3) Do processes identified for smoking behaviour generalise to natural appetitive behaviour?

4) How do processes identified for normal smoking behaviour change during deprivation/abstinence?

Question 1: Episodic smoking motivation

Smoking episodes are preceded by elevated hedonic tone and energetic arousal; mood is not additionally modified by smoking consumption. The implication is that the hedonic effects of smoking initially emerge in predictive/anticipatory processes rather than as a result of consumption. Importantly, this finding suggests that, for a theoretical model to be considered consistent with the experiences uncovered presently, hedonic incentive-sensitisation should be incorporated as a central motivation. Situational context (e.g., socialising) modifies the mood elevation associated with smoking episodes. However, the episodic experience of craving is independent of operative mood changes.

Episodic smoking experiences are shown to vary across persons according to their trait dispositions. Individuals low in approach-reward sensitivity experience greater incentive effects from smoking. These individuals also showed a tendency towards negative hedonic reinforcement in their normal smoking patterns. Although a general model of motivation was derived, an important finding of the present research is that individuals may tend towards different motivational experiences - and that this individual variability may be systematically reflected in trait measures (such as BAS sensitivity).

Question 2: Periodic smoking motivation

Analyses uncovered motivational sequences (over the course of a day) that show much congruence with episodic findings. The primary implication of episodic findings for more general experiences is that smoking should help to regulate hedonic experiences. Periodic analyses showed that times when experiences were less intensely pleasurable were followed by times of more frequent smoking, but the reverse was not true. Smokers might be motivated by a perceived lack of hedonic excitement to later seek stimulation through smoking. A related finding was that periods when participants smoked more were also periods when they perceived unpleasant events to be less salient. Furthermore, smoking frequency predicted subsequent mood: periods of more intensive smoking led to reports of elevated hedonic tone, but not the reverse. Considered in conjunction with episodic findings, the emergent impression is one of smoking as a hedonic regulator, but with a stronger inference that regulation can be driven by gradual motivation – and does not simply reflect responses to immediate external and internal state. Preceding experiences can be seen as motivation setters, modulating sensitivity to acute cues for smoking.

Notably, periodic craving experiences and consumption frequency were not related. This was not an unexpected finding, in light of previous research (Tiffany, 1997). It does, however, bolster conclusions drawn from episodic analyses. Observed episodic mood changes – appetitive increases in hedonic tone and energetic arousal – were not related to parallel craving changes. A possible interpretation of this finding is that it devalues the importance of pre-smoking mood changes as markers of smoking and related processes. Furthermore, if the patterns of mood change are truly reflective of incentive-sensitisation motivation, it might be expected that concurrent urge reports should be closely related manifestations of the proposed "wanting" process (Robinson & Berridge, 2001). However, the lack of relationship

between smoking frequency and craving over time suggests that measures of urge may not be critical indicators of behaviour - a notion consonant with the aforementioned literature. A U function might obscure relationships at the periodic level: high craving in periods of high consumption (multiple pre-smoking elevations) but also when obstructed/in periods of low consumption. In contrast, smoking frequency demonstrated sensitivity to various measures of hedonic experience. Clearly, variability with motivational implications may be independent of urge variability.

Question 3: Comparison with natural consumption

Comparisons with natural consumption behaviour indicated that motivations for natural appetitive rewards differ considerably from those for acquired addictive behaviour. Anticipatory elevation of hedonic tone was isolated as an experience particular to smoking. Furthermore, smoking episodes were associated with particular contexts (relative to natural consumption behaviour), and these were largely contexts that increased pre-smoking hedonic elevation. Similarly, comparisons across periodic data indicated that smoking frequency relates to the intensity of hedonic experience, but natural consumption does not. This may imply that hedonic regulation is an important motivation in substance use and dysfunctional consumption behaviour. Notably, indices of craving and consumption were not related in either behaviour.

Furthermore, the role of personality differed between behaviours. There were more individual differences in smoking- versus eating-related experiences. This was likely a consequence of the different models of episodic mood change. For example, the absence of hedonic reactivity in natural consumption may limit the potential influence of BAS sensitivity. However, the reinforcing nature of food stimuli and involvement of BAS-associated mood (energetic arousal) points to possible

influences of personality in more disparate groups (i.e., those with eating disorders) that may parallel observed moderation of smoking. The distinct interaction of personality and behaviour discerned between the compared behaviours may reflect differences between functional and addictive behaviour-types.

Question 4: Deprivation smoking motivation

The reviewed affective processes (episodic and periodic) were implicated (if not instrumental) in abstinence experiences/lapsing as in smoking. However, it was also found that relationships manifest in deprivation that are dormant in normal smoking. Although the quasi-interventional study only examined a period of acute abstinence, when physiological withdrawal may figure prominently, the affective experiences related to withdrawal have been found to persist beyond this (Gilbert *et al.*, 2002). Such findings suggest that presently identified abstinence experiences may be indicators of long-term cessation experiences/risk factors for relapse.

Abstinence was characterised by increased tense arousal and anger – suggestive of avoidance motivation (mediated by the BIS) and frustrative non-reward. However, smoking episodes during abstinence (lapses) were still preceded by hedonic elevation – a marked effect given that hedonic tone was depressed during deprivation (periodic analyses), suggesting that incentive effects may be especially salient in this state.

A recent study demonstrated that conditioned cues can even be more effective at reinstating smoking than a priming dose of nicotine itself (Caggiula *et al.*, 2001). Such a finding is consistent with the theory of incentive-sensitisation motivation, and serves as a reminder that models influencing the learning and maintenance of a behaviour are further implicated in attempts to discontinue behaviour.

Evidence suggests that craving is "the most salient, frequent, and disconcerting feature of cigarette abstinence" (Tiffany, Cox, & Elash, 2000). In line with this, desire was shown to be particularly elevated during abstinence periods, and this heightened urge state was also evident in episodic pre-smoking reports and recall of recent craving experiences (frequency, intensity, and duration). This finding supports the notion that craving is more perceptually engaging – and possibly, cognitively demanding – when smoking is obstructed (Tiffany, 1997).

Emergent implications

These answers to the central questions of the thesis raise a number of important theoretical implications for models of mood regulation in substance use, the distinction between natural and non-natural/substance consumption, and the role of personality. The following three sections discuss these implications in greater detail. Subsequently, the final two sections consider limitations and contributions of the research and summarise the conclusions of the thesis.

10.2 Implications for models of motivation

At the episodic level, smoking events were preceded by elevation of hedonic tone (above background levels). Hedonic tone was not further elevated after smoking, suggesting that there were no direct effects of consumption per se. With respect to potential models of motivational mood changes (Zinser *et al.*, 1999), this finding supported the incentive-sensitisation account.

Incentive-sensitisation theory (e.g., Lyvers, 1998; Robinson & Berridge, 1993; Stewart *et al.*, 1984) suggests that the reinforcing value of a rewarding behaviour is not related to its direct hedonic impact. For example, drug-taking behaviour can be maintained when subjective hedonic effects of consumption are absent

(Fischman & Foltin, 1991). The present research supported this notion, finding that such consummatory effects were typically absent in smoking behaviour: hedonic reactions to unconditioned reward ('liking'; Berridge & Valenstein, 1991) are unlikely to drive consumption behaviour. The incentive sensitisation theory posits that behaviour is instead motivated by the incentive value of associated stimuli and/or expectation (Siegel, 1988). Such motivation is theoretically manipulated in activation of the behavioural approach system (Zinser *et al.*, 1999; Robinson & Berridge, 1993). The present research supported this notion too; finding that approach related affect (hedonic tone and energetic arousal) was elevated before smoking – and this was partly moderated by approach-trait variability.

Clearly, the present methods do not allow the notional processes underlying incentive-sensitisation theory to be tested. For example, prospective research is required to determine whether initial positive effects of smoking transfer associatively to predictive states and become sensitised whilst tolerance develops to direct (unconditioned) effects. Rather, it can be said that the present findings are more congruent with the incentive-sensitisation interpretation than available others. The implications of this congruency can then be extended according to evidence supporting the existence of an incentive-sensitisation mechanism – or indeed evidence that accurately attributes the appearance of an incentive-sensitisation pattern to real underlying processes.

Compatibility with the Incentive-Sensitisation model?

Two possible issues with the theory remain (though they concern secondary tenets). Firstly, Robinson and Berridge's theory posits that incentive salience attribution should correspond with the extent to which a reward is "wanted" or craved. Results from this thesis show that the urge to smoke is not related to approach mood changes. Urge, energetic arousal and hedonic tone were all elevated before smoking, but the degree of urge elevation was independent of concurrent positive mood changes. This finding – support for the incentive sensitisation model of affective activation, but absence of relationship with craving – actually replicates that of Zinser and colleagues (1999). Pertinently, Carter and Tiffany (2001) also reported that although positive affect and urge increase before smoking, they do not do so in correlation (rather, urge is positively associated with increases in negative affect). Notably, these experimental studies differed from other laboratory work in that they attempted to approximate naturalistic smoking availability. Zinser *et al.* (1999) concluded that urge self-reports are an unreliable index of approach motivation, and that the importance of craving may be over-emphasised in the model formulated by Berridge and Robinson (2001). This conclusion receives support from research that has demonstrated the weakness of urge-smoking predictability (e.g., Tiffany, 1990; Perkins *et al.*, 1997) – a finding recurrent in the present research. Considering the heterogeneity of craving (e.g., Toneatto, 1999) it is perhaps not surprising that variability in this construct did not simply index other approach-related experiences.

The second issue is not an incongruency with the theory, but rather an acknowledgement that the self-report methodology applied in the present research is not considered by Robinson and Berridge to be the most appropriate approach to testing their theory (e.g., Robinson & Berridge, 1995). This is because the theory posits that incentive motivations can sometimes be implicit or unconscious (Berridge, 1999). Actually, this issue might have some bearing on the previously

discussed incongruity: self-reported urge might be an unreliable indicator of wanting, as some information might be lost in the translation from implicit activation to explicit interpretation (Le Doux, 1996; Berridge & Robinson, 1998). Though the theory allows for conscious access to processes that might normally be unconsciously automated, it warns that subjective feelings are secondary indicators of underlying shifts (Robinson & Berridge, 2000). The presently adopted diary design represents a self-report protocol that may have been more suited than most to assessing approach related motivations. Participants are not asked to consciously connect events to mood responses - as they might be in global reports – rather, current-state assessments are made at critical junctures and processes inferred from analysis of change scores: participants do not have to interpret their own motivations (Baker *et al.*, 2004b). Assessments were intended to minimise any interruption of ongoing processes: sampling is brief, and participants are instructed to give their initial responses. Moreover, the diary design takes repeated snap-shots of subjective state across various naturally occurring smoking situations. This should facilitate more reliable assessments of experience than one-off laboratory or recall-based questionnaire measures – and could compensate somewhat for the purported unreliability of self-report. Furthermore, the fact that feelings are assessed contiguously to smoking should ensure that that reports tap the theoretically relevant processes (Zinser *et al.*, 1999).

Interpretation

It should be stressed that the present research does not constitute a definitive test of the main motivational models as they apply to smoking. It is likely that the models considered are not mutually exclusive, and may be relatively more or less evident in individuals according to their personality and stage of smoking development/change. This is a notion supported by modelling that found the tendency to experience particular patterns of mood-smoking (incentive-sensitisation, appetitive-incentive, or associative-withdrawal) was moderated by

personality. However, the present findings do indicate an overall trend that fits the incentive-sensitisation model better than other models originally compared – and this is consonant with research applying a variety of different experimental methodologies (Balfour, 2003; Zinser *et al.*, 1999; Donny *et al.*, 2003).

A key condition of the association between smoking and pre-act hedonic boosts seems to be the expectation that smoking intentions will be implemented. Deprivation is another condition that may modify the extent to which this association is apparent: low deprivation permits examination of normal smoking-related changes without withdrawal/obstruction related affectivity that may obscure positive hedonic motivation. The evidence for this partly comes from previous research: studies have typically investigated smoking during deprivation and/or without expectation to smoke (Dols *et al.*, 2000; Gilbert, 1995); this research (though inconsistent – Kassel *et al.*, 2003) tends to suggest that negative mood changes prime smoking (Dobbs *et al.*, 1981; Payne *et al.*, 1991); some recent studies demonstrate that, when smokers are able to smoke (and have not been restricted prior to testing), cueing of smoking is more likely to involve positive mood (Sayette *et al.*, 2003; Carter & Tiffany, 1999; Shapiro *et al.*, 2002). Further evidence for this conditional association derives from the present research: pre-smoking hedonic elevation was shown in everyday behaviour when participants were preparing to smoke (intention with subsequent implementation); pre-smoking hedonic elevation remained apparent when participants attempted to restrict their smoking (i.e., between intention and implementation of lapses); but deprivation, and the pre-lapse state, were also marked by greater negative affectivity (dimensional anger and tense arousal).

Taken together, it is clear that the current research builds on a body of work that has looked at smoking under more naturalistic conditions (in environments where smoking is permitted, and without interventional deprivation), and found that

smoking may be associated with hedonic expectations and pleasure-related contexts (Mucha *et al.*, 1999; Huston-Lyons & Kornetsky, 1992; Shapiro *et al.*, 2002; Zinser *et al.*, 1999). The present research (specifically, the quasi-interventional study) also demonstrated how different affective processes may emerge in the motivation of smoking after abstinence/when encouraged not to (e.g., Kassel *et al.*, 2003). These processes are more consistent with literature supporting negative reinforcement in episodic smoking (e.g., Hutchison, Niaura, & Swift, 1999) - with the implication that findings reflect methodological approach - and are discussed in the next sub-section.

Reconciling reinforcement processes during normal versus deprivation smoking

How might deprivation effects be integrated with incentive cueing of smoking? During normal smoking behaviour, anxiety does not appear to be a key component of motivation, but it emerges as being more prominent during deprivation: a pattern of negative reinforcement is suggested, with increased anxiety cueing smoking, and smoking ameliorating anxiety. How is this accounted for within the incentive-sensitisation account that has been supported thusfar (Robinson & Berridge, 1993)? It could be that anxiety emerges through unconditioned physiological withdrawal (e.g., Gold, Washton, & Dackis, 1985) – consistent with apparent direct attenuation by nicotine consumption (versus incentive effects). Unconditioned withdrawal would not be expected to be associatively reinforced. It might further be that anxiety is a secondary learning experience, a response to reduced reward sensitivity during deprivation experiences such that it becomes a conditioned cue of punishment avoidance – with smoking as the motivated avoidance behaviour. The co-occurrence of anxiety and hedonic elevation before lapse episodes is consistent with incentive-sensitisation theory (Piazza & Le Moal, 1998): tense arousal (as induced during abstinence) should increase the incentive salience of smoking cues.

An alternative view (Baker *et al.*, 2004b) is that negative affect/anxiety is the prototypic setting occurrence for substance use and lapse events. In this view, withdrawal experiences occur from very early in smoking experimentation, such that each smoking episode after the first strengthens negative reinforcement of withdrawal anxiety – producing learning that smoking provides expeditious alleviation of aversive affect. This association is theorised to become preconsciously automated, with smoking events occurring before negative affect becomes prominent. The exception to this is when smoking is obstructed (as in a deprivation intervention): anxiety mounts, enters consciousness, and biases information processing towards drug-seeking. Baker and colleagues suggest (2004a) that smoking to avoid negative affect increases the positive incentive value of use. In this way, during normal smoking, behaviour may seem driven by approach affectivity. Thus, this theory also accommodates present observations of both positive incentive effects (normal smoking) and negative reinforcement (deprivation). In the future, carefully controlled research may be required to test this very recent redevelopment of negative reinforcement theory (proposing to account for positive incentive effects) against incentive-sensitisation theory. The different underlying processes are likely to only be observable very early in the acquisition of behaviour.

10.3 Implications of distinction from natural consumption

It may be inferred from comparison data that processes relating to smoking behaviour are distinct from those in natural consumption behaviour. Tables 10.1 and 10.2 present the main comparative findings for episodic and periodic motivation respectively. This section attempts to interpret these differences: why might models of motivation differ between the observed behaviours, and what are the ramifications of this divergence?

Table 10.1

Episodic processes between behaviours

Smoking Episodes	Eating Episodes
Anticipatory elevation of hedonic tone	
Anticipatory elevation of energetic arousal	
	Consummatory elevation of energetic arousal
Incentive-sensitisation pattern of mood changes	Appetitive-incentive pattern of mood changes
Relative tendency to occur in social locations; whilst active; with alcohol consumption.	Relative tendency to occur at home; when resting; whilst working/studying.
Inverted-U function of desire to consume/craving	
Anticipatory desire increases with tense arousal and anger and in particular contexts (social locations, after sex).	Anticipatory desire only relates to content of consumption (i.e., selected food groups).

Table 10.2

Periodic processes between behaviours

Smoking	Eating
Smoke more frequently within periods of heavy drinking (reactive)	Eat more frequently after periods of heavy drinking (restorative)
Smoke more frequently after periods of low-intensity pleasure. Unpleasant experiences less intense during periods of more smoking.	Eating frequency unrelated to periodic hedonic experiences (current or lagged).
Consumption frequency and craving experiences unrelated (though share some correlates).	

Markers for addictive/dysfunctional behaviour

Experiential differences between smoking and natural appetitive behaviour could represent markers for problem behaviour/dependence. For example, comparisons indicated that smoking is motivated by pleasure motivations that are not present in the natural appetitive impetus towards food consumption. A tentative generalisation from this is that hedonic incentive effects may be particularly associated with behaviours like drug use and gambling as compared with more functional behaviours. It might also be that compulsive patterns of eating behaviour develop in individuals who experience hedonic priming of food consumption. Participants sampled in the present research were within the normal BMI range and seemed to have normal attitudes towards eating; it would be interesting to see how eating episodes differ in individuals with abnormal consumption attitudes and behaviours – and specifically, to observe whether hedonic experiences play a greater role. Models of dysfunctional eating behaviour may resemble those identified for smoking more closely (Carter & Bulik, 1994; Staiger, Dawe, & McCarthy, 2000). This approach to interpreting differences between behaviours suggests that eating helps to regulate physiological arousal: expectations and taste effects relate to elevation of energetic arousal and consumption increases after periods of heavier alcohol use (suggesting functional use of eating to replenish and reenergise).

Do apparent motivational differences simply reflect situational differences?

Smoking tended to occur when happiness was elevated, and happiness was elevated in particular situations: in social venues, with other people, when drinking alcohol and after performing other rewarding behaviours (sex and eating). Furthermore, smoking was particularly associated with three specific states (relative to eating episodes) and two of these states were contexts associated with enhanced pre-smoking happiness: (1) being in social venues and (2) drinking alcohol. Evidence suggests therefore that smoking is more likely to occur in situations that are associated with hedonic elevation. This is consistent with recent

research showing that smoking cues tend to be appetitive and rated as pleasant (Bushnell *et al.*, 2000; Mucha *et al.*, 1998; Mogg *et al.*, 2003). An inferential pathway that might follow from this is that smoking is triggered in particular contexts, these contexts are pleasurable (elevate hedonic tone), hence smoking appears to be associated with hedonic effects – but such effects are actually an epiphenomenon of smoking-context associations.

The key issue here is really about the generality of hedonic effects. Hedonic associations with smoking could develop through secondary conditioning (smoking to external context, external context to mood), but still become associated with smoking such that hedonic regulation emerges independently of specific situational contingencies (Gewirtz & Davis, 1998). Clearly, the development of a general mood-smoking link has greater implications than mood-smoking correlations that are simply reflective of particular contextual associations. For example, the latter interpretation would suggest that avoidance of identified situations (e.g., drinking alcohol) would do much to extinguish cueing, whereas the former interpretation suggests that smoking might be cued by mood changes in any situation (potential trigger feelings transcend situations identified for avoidance). Present data suggested that smoking episodes are elicited in pleasurable contexts, but hedonic incentive effects in smoking were not explained by any combination of such contexts (hedonic variance remained significant when identified pleasurable contexts were entered as covariates). A possible implication of this is that preparation to smoke has positive mood effects that are somewhat independent of situational cueing – this is consistent with evidence that expectancies/internal drives are more important than specific external cues per se (Dols *et al.*, 2002; Juliano & Brandon, 1998). Thus smoking behaviour can enhance hedonic tone in pleasurable circumstances: preparation of smoking is a response to circumstances that stimulate hedonic tone. But anticipatory hedonic boosts are not contingent on these circumstances: smoking can be cued in other situations, where preparatory

processes produce similar mood elevation – allowing the smoker to emulate pleasant feelings that might not otherwise be associated with their current situation.

Do apparent differences reflect issues with comparability of behaviours?

One potential problem with comparing eating and smoking so as to make conclusions about related affective processes is that the former behaviour may be more heterogenous than the latter. It is likely that there are different processes underlying consumption of meals versus snacks, or sweet foods versus vegetables – differences that might be obscured if eating episodes are treated as homogenous, and may give an aggregate impression that does not represent actually occurring processes (but rather, the best fit to numerous distinct mechanisms). For this reason, variability in food type and episode type (snack/meal) was factored into analyses of eating episodes. It was considered that snacking episodes would be most akin to smoking episodes (shorter duration, potentially more impulsive/less overtly functional), such that the hedonic motivations observed in smoking might be more evident in this particular type of consumption episode. However, analyses utilising only snacking data produced results that did not differ from those using the full eating data-set. Similarly, episodic mood did not covary with food type.

One common feature to smoking and eating behaviour is that consumption was not related to craving in a predictable way. A specific factor that may have obscured urge-behaviour correspondence in food consumption data is that frequency may not be the best indicator of urge response. The content of consumption should be considered, especially in eating events - where variability in portioning and choice of consumable is likely to be greater than for smoking. Episodic analyses demonstrated that this is an important consideration for natural consumption: urge to eat was greater in episodes when more substantial food types were selected (meal staples like proteins, grains, and vegetables). In principle, similar

considerations might be applied to smoking too. However, episodic assessments of consumption variability in smoking (rod left, extent inhaled) did not show any association with urge state. The implemented indices of consumption may not be sensitive or accurate enough to support a firm conclusion on this matter, but it appears that behavioural frequency may be a better measure of consumption in smoking as compared with eating.

10.4 Role of personality

Discussion in this section turns to interpretation of findings in relation to personality theory. The first sub-section considers the implications of BIS/BAS moderation in present findings for the reinforcement sensitivity theory (RST; Gray, 1987) from which central measures were derived. Are findings consistent with RST? Do they suggest re-interpretation of theory? Indeed, are they actually more congruent with alternative motivational theories – such as Eysenck's arousal theory (Eysenck, 1990)? Note that discussion of RST refers to the pre-reformulation conceptualisation (Gray & McNaughton, 2000), although coherent conclusions can be drawn with reference to reformulated theory.

The second section is concerned with implications for construct validity. How does the concordance of Big Five and BIS-BAS measures relate to theoretical trait space, and which model of personality is supported by their influence? It is beyond the scope of the present research to truly test different theoretical models of personality, but current findings do offer insight. Another pertinent question is whether the convergence of personality measures is informative about the nature of BAS: is it better conceptualised as impulsivity or extraversion (Gray, 1981; Depue & Collins, 1999)? The answer has implications for the future measurement of motivation.

10.4.1 The moderating influence of BIS-BAS

Of particular theoretical relevance to the present research is the notion that appetitive behaviours - and affective correlates of appetitive processes - are driven by an underlying behavioural approach system (Depue & Collins, 1999; Cloninger, 1987). To the extent that hedonic tone and energetic arousal are affective responses generated by BAS (Carver & Scheier, 1998), the reviewed episodic and periodic smoking data offers preliminary support for the notion of smoking as a BAS-related activity. The emergence of BIS-related tension and frustrative (non-reward) mood during deprivation is also consistent with recent clarification of theory (Corr, 2002) given that the abstinence situation introduces conflict between competing goals (approach and avoidance). Thus, emotional responses to smoking provide initial support for the BIS/BAS model of motivation. In terms of trait variability, BAS sensitivity (specifically, reward responsiveness) moderated the hedonic component of appetitive responses before smoking. At this point, findings deviate from the expected somewhat.

It was originally predicted – in line with the basic tenets of RST (Pickering *et al.*, 1999) and previous findings (e.g., Zinbarg & Mohlman, 1998; Heubeck *et al.*, 1998) - that BAS sensitivity would dispose greater learning and approach response. In practice, current findings suggest that low-BAS individuals are more reactive to incentive effects of smoking on hedonic mood. That is, their hedonic mood was more elevated than that of high-BAS individuals. Possible implications of this finding have been discussed previously. Cook and colleagues (2004) anticipated the observed direction of moderation. They proposed that individuals who are less responsive to reward may get greater hedonic stimulation from smoking and related expectancies (Cook *et al.*, 2004). Acceptance of this notion might be viewed as a challenge to Gray's theory. An interpretation that would be easier to accommodate is that the better reinforcement learning of individuals who are highly

reward responsive supports development of bidirectional hedonic cueing (positive and negative reinforcement), such that average pre-smoking elevation appears relatively low. This tendency has been shown in alcohol research (Franken, 2002). The observed moderating effects could be interpreted within the Eysenckian account of personality (Eysenck, 1991): more introverted (low-BAS) individuals tend to be more reactive to smoking cues and expectations (low-level stimulation). However, previous research indicates that the arousal effects predicted by Eysenck operate in reinforcement-neutral conditions (Corr, Pickering, & Gray, 1997). Given the reinforcing nature of smoking (Glautier, 2004), this interpretation may be less preferred than attempts to reconcile the finding with Gray's theory.

Is the direction of moderation truly at odds with Gray's theory? The theory posits that BAS governs reward sensitivity – in terms of both behavioural activation and generation of associated mood. High BAS individuals should be more responsive in their approach behaviour and mood change when exposed to cues of reward. Consequently, in relation to the incentive-sensitisation pattern of mood change demonstrated in present smoking data, these individuals would be expected to report particularly strong hedonic elevation in the cued anticipatory state (relative to low-BAS individuals). Clearly, this prediction was not supported by the present research. Reward responsive individuals are more likely to have generally elevated hedonic tone (Gable, Reis, and Elliot, 2000), such that smoking may be less salient as an expected reward and have less pronounced affective effects. However, Carver and White (1994) have previously demonstrated that reward responsiveness positively predicts happiness in anticipation of reward – and that this relationship holds when baseline rating is partialled out. It might be difficult to reconcile this finding with the present results without entering into speculative reasoning about the value of different rewards and laboratory-field influences.

Perhaps though, the effect reported by Carver and White (1994) is not fully comparable to present observations: although presented as a test of impending reward, their results may reflect post-reward state. In the design they implemented, the cue of impending reward was a message stating that the participant had gained extra research credits. This message was followed by an assessment of mood before the experimenter was called; the transfer of research credits was then formalised and the experiment terminated – despite previous information suggesting that this was the half-way stage of the experiment. Participants may have anticipated the formal credit-transfer and future credit-gaining opportunities, but it could be argued that the intangible reward of credit (relative to the act of smoking) was also processed as 'received' from the moment that the participant was informed of their success (i.e. before mood assessment). The distinction between pre- and post-reward affect is potentially important. Credit awards were both novel and valuable - participants had yet to attain any research points despite course requirements that they do so - and would likely stimulate positive mood directly, in a way that repeat smoking may not (consistent with incentive-sensitisation learning).

Attenuated responses to smoking cues in those with greater reward sensitivity may be explained in terms of encoding of reward expectations and better learning in the context of reward. Corr (2001) stresses the (often neglected) importance of reward expectations as a determinant of the strength of reaction to a reinforcer. During development of smoking behaviour, mood effects may be less likely to exceed the higher expectations of reward responsive individuals. Expectation-modulated direct effects might be encoded in the process of incentive-sensitisation, such that high-BAS individuals acquire anticipatory effects of lower intensity (relative to their low-BAS counterparts). Similarly, if - as theory suggests - reward responsive individuals are better at learning in relation to reward, it may follow that they learn to modify their anticipatory response over time as a reaction to the absence of direct effects

in repeat smoking. These potential explanations for the observed BAS moderation are consistent with postulates of RST.

Finally, BAS sensitivity was also implicated in moderation of episodic craving. Specifically, those high in BAS drive found smoking to be less satiating. This is consonant with conceptualisation of this subscale as reflecting persistent approach activation that is relatively insensitive to intrinsic affective values (Carver & White, 1994; Johnson *et al.*, 2003). It may be inferred from this that smokers strong in this trait demonstrate a chronic behaviour-facilitating impetus that may be somewhat unresponsive to 'off' cues afforded by signals of reward actualisation. Such a view of BAS drive is in agreement with other effects of this trait: stronger urge when smoking is obstructed, lower reactivity of smoking frequency to periodic alcohol use (suggesting less sensitivity to hedonic sensitisation of approach behaviours), and moderation of craving for other behaviours - BAS drive also influenced food craving (implying a more general role in desire control). BAS sensitivity was generally not affiliated with eating behaviour – as befitting the relative lack of approach affectivity implicated in food consumption (at least in terms of hedonic tone) – but the role of BAS drive seems more reasonable considering its limited role, conceptually, in hedonic (or indeed, affective) motivation. In situations/individuals for whom food is particularly rewarding (particularly, hedonically stimulating), stronger moderation by BAS might be expected (moderation should generalise across comparable reinforcement behaviours - at least for conditioned affective responses to these behaviours).

10.4.2 Implications for personality theory and assessment

Further to the BIS-BAS scales, a second measure of personality (the Big Five) was applied in the present research. It was intended that examination of big five variability would chiefly serve a descriptive purpose, characterising the role of

individual variability in a way that would compliment theoretically driven investigation in terms of BIS and BAS. The adopted measure of the big five was based on trait descriptions in the natural language, rather than a biotheoretical model (Goldberg, 1993). There is some debate as to what the best self-report measure of BIS and BAS might be, and it seemed reasonable to apply multiple measures that could tap relevant variability (Corr, 2001). A question emergent from the present application of two personality measures is: can the influence of the derived trait variables be integrated in a theoretically meaningful way?

Overall, findings for moderation by Big Five traits showed congruency with theoretical accounts of BIS and BAS. Although researchers have mapped both BIS/BAS and the Big Five in relation to Eysenckian trait space, it could not necessarily be assumed that a measure born of everyday language would be highly consistent with a measure that was designed to tap biologically-based BIS/BAS sensitivity directly (although related experiences should find expression in language). An example of consistency between measures, in relation to Gray's theory, was the overlapping influence of BAS reward responsiveness and Surgency. Moderation of pre-smoking hedonic elevation by Surgency suggested that elevation was attenuated in those with relatively more BAS than BIS sensitivity (theoretically, extraversion emerges from the interaction of these systems; Gray, 1981). However, the example moderation was better explained by BAS sensitivity alone: hence the influence of Surgency disappeared when modelled jointly with BAS score. Notably, of the other big five constructs, Emotional Stability emerged as a moderating influence over and above the assessed BIS/BAS traits. This is appropriate considering that the BAS scales (Carver & White, 1994) do not reflect the theorised contribution of Neuroticism (low ES) to BAS sensitivity (as well as BIS sensitivity; Gray, 1982). The measure of Emotional Stability thus compliments assessment of BIS/BAS influences in the present research.

What remains is the question of which conceptualisation of BAS is favoured: do data from the applied measures provide a better fit to Gray's hypothesis that extraversion and neuroticism derive from the interaction of BAS and BIS (impulsivity-anxiety; Gray, 1981), or to the proposal that agentic extraversion is the most apt measure of behavioural activation (Depue & Collins, 1999; also see Diaz & Pickering, 1993)? Current findings fit both perspectives. Carver and White's bespoke measure of BAS is highly related to extraversion (but not neuroticism) such that its superiority to Surgency in capturing moderation cannot be taken as evidence against the proposal of Depue and Collins (1999), despite the fact that the BAS scales were developed from Gray's original RST. Similarly, the moderating influence of neuroticism does not differentiate the two accounts: neuroticism is viewed as a constraint factor acting on BAS in Depue and Collins' model, and as a component of BAS in Gray's model. What can be stated (in line with theoretical discussion by Depue and Collins) is that BAS (as measured in the present research) appears to be a complex emotional system, perhaps involving heterogenous sub-traits. For example, higher BAS reward responsiveness disposed greater reactivity between smoking and alcohol consumption but higher BAS drive attenuated this reactivity. These patterns of moderation show consistency with findings that reward responsiveness is implicated in cross-sensitisation of positively reinforcing behaviours (Powell *et al.*, 2002), and that drive disposes greater general urge – such that smoking may be less reactive to particular stimuli. Further, they support the multidimensional assessment of BAS when utilising the scale items of Carver and White (1994; Johnson *et al.*, 2003), and may bolster Depue and Collins' (1999) argument for the assessment of BAS as reflecting various distinct processes (potentially reflecting different substrates).

What can be concluded about the measurement of motivational tendencies? It could be argued that the involvement of BAS/BIS is best assessed in terms of theoretically associated mood processes (e.g., hedonic tone for BAS, tense arousal

for BIS) where there is little agreement on trait measures of motivational sensitivity (Coan & Allen, 2003). Individual differences in mood intensity and reactivity could be useful indicators of underlying traits. Others have suggested that any comprehensive approach to personality assessment will converge on the same personality space (e.g., Church, 1994): putting the onus on interpretation of each scale in reconciling findings from different approaches. The two measurement approaches used presently appeared complimentary. The specifically-tailored BAS measure was better at capturing variance related to extraversion/impulsivity than the big five Surgency scale, but measurement of neuroticism/emotional stability augmented description of moderation in a way that is consistent with RST.

10.4 Limitations and Contributions

Limitations of the present research

As discussed in methodological chapters, the reliance of present research on self-report diary protocols may have introduced various biases. For example, although the advantages of real-time assessments are considerable, the burden of diary completion may have partially interfered with normal patterns of smoking-related state-change and behaviour. Diary-based self-reports require that the participant is also the observer, and the conflict between these roles may have influenced responses. Moreover, the paper-based diary protocol is particularly open to issues of compliance (Stone *et al.*, 2002). Although this issue may be difficult to circumnavigate for event-contingent assessment, an electronic diary could have provided more accurate compliance data for periodic assessments (by time-stamping reports). The present research followed proposed guidelines for maximising the compliancy of paper-based diary design (Bolger *et al.*, 2003; Scollon *et al.*, 2003). More generally, it is conceivable that some processes involved in behaviour are not available to self-report. In this way, self-reported affect

measures may not index motivation accurately – although there is a convergence of evidence suggesting that it can (Baker *et al.*, 2004b).

Emotion might best be understood as a primitive action-moderator that is sensitive to stimuli of valence in the maintenance of homeostasis. Cognition may access and even modulate emotion, but in both respects it is secondary. Thus, the findings of the present thesis – based as they are on subjective reports of experiences at the cognitive level – would be bolstered by examination of implicit emotional processes and autonomic/endocrine responses as they relate to naturalistic smoking behaviour. Nonetheless, the results obtained in the present thesis from cross-lagged analyses of temporal processes in subjective mood offer some insight into causal sequences (though it is not clear here whether subjective representations have a causal influence on subsequent behaviour so much as they reflect gradual changes in underlying processes). Further inferences can be made based on the temporal structure of smoking events, though it has been discussed (Chapter 1) that subjective reports of mood subjective reports of mood do not provide a complete picture of emotional response – and are open to other influences (occurring as they lag behind initial physiological responses to emotional stimuli)

A related issue is that the present approach to sampling temporality in smoking behaviour may not provide the optimal window for understanding key processes. For example, assessment of pre-smoking mood allows change from baseline to be calculated, but it does not allow insight into the meaning of this mood change: does it reflect a primary cueing state or an anticipatory mood response to imminent smoking (that may have been originally cued by other state changes)? It is difficult to see how this could be differentiated in naturalistic study of smoking. Smokers may not be consciously aware of any primary cue for their smoking behaviour (the present approach inferred motivational shifts by comparing current state reports made at different times relative to smoking). Urge-contingent reports may be

useful in this regard – that is, state recordings when a salient urge to smoke is experienced. However, this would introduce further unreliability into assessment as the perceived experience of an urge event (i.e., what state should prompt a report) may vary greatly across individuals in a way that concrete events (such as smoking) do not. It also seems likely that urge and behaviour are not related in predictable ways, such that findings for urge cueing may not be applicable to smoking events.

The present research is somewhat limited by its observational/quasi-experimental nature. On their own, present findings may be difficult to interpret in terms of potential mechanisms and causality (although cross-lagged analyses allow strong inferences to be made). However, the strength of the present research is in its convergence with other experimental, theoretical, and anecdotal reports. Thus, the current research tested the fit of observed relationships to different theoretical models and considered outcomes in relation to experimental evidence, where available. Similarly, participant selection in the reported studies may limit the extent to which current findings generalise, but applicability may be inferred where other studies have uncovered similar relationships in different populations. A particular concern in the present research is that sampled smokers tended to be low in dependence – smoking motivation may differ somewhat at different levels of behavioural severity. However, markers of dependence were examined as moderators, and these facilitated understanding of processes for which heavier smokers may tend towards different experiences.

Future research should elaborate on individual variability in smoking-related mood, and compare affective responses to smoking with affective responses to other types of substance use (for example, alcohol use) to establish whether the present results are specific to smoking or generalise across dependence behaviours. Such research would also determine the generality of trait-moderated patterns of mood change

across dependence behaviours. The present findings should encourage investigation of how mood-smoking relationships translate into mood-urge/relapse relationships during long-term abstinence, and how these patterns might vary systematically between persons. Furthermore, the findings have practical implications for the application of monitoring protocols in clinical assessment. Evidence for individual variability in everyday smoking situations and motivational responses suggest that personalised monitoring of the kind undertaken by participants in present diary studies may be useful. In the diagnostic stage, such monitoring would identify individual correlates of smoking that may require specific targeting in treatment. During abstinence, monitoring would help to identify changes (e.g., depressed mood) that may require individualised attention in relapse prevention. Also, recording of situations surrounding any lapse episodes may reveal 'triggers' that only emerge for an individual during deprivation. Coping strategies could then be developed accordingly.

10.5 Conclusions

Uniquely, the present thesis tested competing theoretical accounts of smoking motivation as they apply to everyday mood regulation. Findings converged with more recent, naturalistic experimental research in support of positive incentive-based motivation (during normal unrestricted smoking). Complimentary analyses of general (episode-removed) periodic experiences indicate that smoking frequency increases after periods of reduced pleasure: consistent with the notion of smoking to enhance positive mood intensity. The present thesis applied a novel hierarchical approach that went beyond the level of momentary processes: to consider the role of personality (and especially reward sensitivity) as moderating mood-smoking relationships. In doing so it uncovered evidence that BAS disposes less anticipatory pleasure (contrary to expectations) and less consummatory satiation from smoking. The former of these findings may cast new light on previous assumptions about the

nature of reward sensitivity: underlining the importance of distinguishing general mood tendencies from within-person reactivity to specific states.

Extending the scope of this hierarchical approach, present research has identified a parallel affective-motivational model for natural appetitive behaviour, and indicates that this model is distinct from smoking (non-natural reward). The thesis has further uncovered distinctions between everyday use and use under conditions of restricted availability – with the implication that motivational-interpretation is very sensitive to deprivation state. This may help to explain the equivocal nature of previous research. Specifically, negative mood cues and positive effects of consumption on mood are more pronounced during restricted versus everyday smoking.

In relation to established theoretical frameworks and experimental research, the present thesis makes a significant contribution to our understanding of hierarchical affective motivation as applied to smoking behaviour. Further, it offers insight from naturalistic data that may usefully inform future theoretical development and experimental paradigms.

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Appendix A. Smoking diary materials

Smoker History

Gender: ☐ Male ☐ Female (Please tick as appropriate)

Date of Birth: _____

The following questions gather background information about your smoking behaviour. Please write your answer to each question in the appropriate space.

How old were you when you smoked your first cigarette? _____

How long have you been smoking at your current rate? _____

When smoking the heaviest, how many cigarettes did you smoke per day? _____

What brand are you currently smoking? _____

How many serious attempts to quit smoking have you made?
Total number _____

Readiness to Change

How strong is your desire to quit smoking?

Please indicate the extent of your desire to quit smoking on the scale below. The scale ranges from 1 to 10, where 1 indicates that you have no desire to quit smoking and 10 indicates that you have a very strong desire to quit smoking.

1 (No desire) 2 3 4 5 6 7 8 9 10 (Very strong desire)

How confident are you in your ability to quit smoking?

Please indicate the extent of your confidence in your ability to quit smoking (if you were to decide that you wanted to quit) on the scale below. The scale ranges from 1 to 10, where 1 indicates that you have no confidence in your ability to quit smoking and 10 indicates that you have absolute confidence in your ability to quit smoking.

1 (No confidence) 2 3 4 5 6 7 8 9 10 (Absolute confidence)

How addicted to smoking do you perceive yourself to be?

Please indicate the extent to which you believe you are dependent on smoking on the scale below. The scale ranges from 1 to 10, where 1 indicates that, in your opinion, you are not at all addicted to smoking, and 10 indicates that, in your opinion, you are heavily addicted to smoking.

1 (Not at all) 2 3 4 5 6 7 8 9 10 (Heavily addicted)

Indicate your response to each question by ticking the appropriate box below it.

How much do the people closest to you want you to stop smoking?

- ☐ They want me to continue smoking
- ☐ They don't care one way or the other
- ☐ Somewhat
- ☐ Very much

Among your close friends, what percentage would you say smoke?

- ☐ Almost none
- ☐ Less than 25 percent
- ☐ Between 25 and 50 percent
- ☐ About half
- ☐ Between 50 and 75 percent
- ☐ More than 75 percent

Among the students on your course, what percentage would you say smoke?

- ☐ Almost none
- ☐ Less than 25 percent
- ☐ Between 25 and 50 percent
- ☐ About half
- ☐ Between 50 and 75 percent
- ☐ More than 75 percent

Which of your relatives smoke? (Tick all that apply)

- ☐ Parent(s)
- ☐ Sibling(s)
- ☐ Grandparent(s)
- ☐ Partner
- ☐ Other_____

Revised FTQ

1. How many cigarettes a day do you smoke? (circle one)

10 or less	11-15	16-20	21-25	26 or more

2. How deeply do you inhale? (circle one)

1	2	3	4	5
I do not inhale		Moderately		Very Deeply

3. How often do you smoke more in the morning than the rest of the day?

1	2	3	4	5
Never		About half the time		Always

4. How often do you smoke your first cigarette within 30 minutes of waking? (circle one)

1	2	3	4	5
Never		About half the time		Always

5. How difficult would it be for you to give up your first cigarette of the day? (circle one)

1	2	3	4	5
Not Difficult		Somewhat Difficult		Extremely Difficult

6. How difficult do you find it to refrain from smoking in places where it is forbidden (e.g. in church, at the library, cinema, etc.)? (circle one)

1	2	3	4	5
Not Difficult		Somewhat Difficult		Extremely Difficult

7. How often do you smoke when you are sick with a cold, the flu, or are so ill that you are in bed for most of the day? (circle one)

1	2	3	4	5
Never		About half the time		Always

8. On average, about how much of the cigarette do you smoke? (circle one)

1	2	3	4	5
½ or less	½	2/3	¾	ALL

9. On average, how often do you inhale? (circle one)

1	2	3	4	5
Never		About half the time		Always

10. On average, how often do you hold cigarette smoke in your lungs for a moment or two before exhaling? (circle one)

1	2	3	4	5
Never		About half the time		Always

MORNING ASSESSMENT: Please complete prior to lunch.

The assessment consists of 2 measures: the UWIST Mood Adjective Checklist and the QSU-Brief Form.

Take the assessment at a time when you are not smoking.

Please do not complete this assessment immediately before or after smoking.

Aim for a time when you have not recently smoked and are not preparing to smoke imminently.

When you are ready to complete the 2 measures overleaf, enter the current time below.

TIME NOW: _____

UWIST Mood Adjective Checklist

MORNING ASSESSMENT: Part 1 of 2 (continues on next page)

Instructions

*This section of the questionnaire is concerned with your current feelings. Please answer **every** question, even if you find it difficult. Answer, as honestly as you can, what is true of **you**. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you feel **AT THE MOMENT**. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.*

*Here is a list of words that describe people's moods or feelings. Please indicate how well each word describes how you feel **AT THE MOMENT**. For each word, circle the answer from 1 to 4 which best describes your mood.*

	Definitely	Slightly	Slightly Not	Definitely Not
1. Happy	1	2	3	4
2. Dissatisfied	1	2	3	4
3. Energetic	1	2	3	4
4. Relaxed	1	2	3	4
5. Alert	1	2	3	4
6. Nervous	1	2	3	4
7. Passive	1	2	3	4
8. Cheerful	1	2	3	4
9. Tense	1	2	3	4
10. Jittery	1	2	3	4
11. Sluggish	1	2	3	4
12. Sorry	1	2	3	4
13. Composed	1	2	3	4
14. Depressed	1	2	3	4
15. Restful	1	2	3	4
16. Vigorous	1	2	3	4
17. Anxious	1	2	3	4
18. Satisfied	1	2	3	4
19. Unenterprising	1	2	3	4
20. Sad	1	2	3	4
21. Calm	1	2	3	4
22. Active	1	2	3	4
23. Contented	1	2	3	4
24. Tired	1	2	3	4
25. Impatient	1	2	3	4
26. Annoyed	1	2	3	4
27. Angry	1	2	3	4
28. Irritated	1	2	3	4
29. Grouchy	1	2	3	4

QSU-Brief Form

MORNING ASSESSMENT: Part 2 of 2

Instructions

*Indicate how much you agree or disagree with each of the following statements by circling the appropriate score on the scale below it, ranging from 1 (you **strongly disagree** with the statement above) to 7 (you **strongly agree** with the statement above). Please complete every item. We are interested in how you are thinking or feeling **right now** as you are filling out the questionnaire.*

1. I have a desire for a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

2. Nothing would be better than smoking a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

3. If it were possible, I probably would smoke now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

4. I could control things better right now if I could smoke.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

5. All I want right now is a cigarette.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

6. I have an urge for a cigarette.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

7. A cigarette would taste good now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

8. I would do almost anything for a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

9. Smoking would make me less depressed.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

10. I am going to smoke as soon as possible.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

EVENING ASSESSMENT: Please complete in the evening.

The assessment consists of 2 measures: the UWIST Mood Adjective Checklist and the QSU-Brief Form.

Take the assessment at a time when you are not smoking.

Please do not complete this assessment immediately before or after smoking.

Aim for a time when you have not recently smoked and are not preparing to smoke imminently.

When you are ready to complete the 2 measures overleaf, enter the current time below.

TIME NOW: _____

UWIST Mood Adjective Checklist

EVENING ASSESSMENT: Part 1 of 2 (continues on next page)

Instructions

*This section of the questionnaire is concerned with your current feelings. Please answer **every** question, even if you find it difficult. Answer, as honestly as you can, what is true of **you**. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you feel **AT THE MOMENT**. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.*

*Here is a list of words that describe people's moods or feelings. Please indicate how well each word describes how you feel **AT THE MOMENT**. For each word, circle the answer from 1 to 4 which best describes your mood.*

	Definitely	Slightly	Slightly Not	Definitely Not
1. Happy	1	2	3	4
2. Dissatisfied	1	2	3	4
3. Energetic	1	2	3	4
4. Relaxed	1	2	3	4
5. Alert	1	2	3	4
6. Nervous	1	2	3	4
7. Passive	1	2	3	4
8. Cheerful	1	2	3	4
9. Tense	1	2	3	4
10. Jittery	1	2	3	4
11. Sluggish	1	2	3	4
12. Sorry	1	2	3	4
13. Composed	1	2	3	4
14. Depressed	1	2	3	4
15. Restful	1	2	3	4
16. Vigorous	1	2	3	4
17. Anxious	1	2	3	4
18. Satisfied	1	2	3	4
19. Unenterprising	1	2	3	4
20. Sad	1	2	3	4
21. Calm	1	2	3	4
22. Active	1	2	3	4
23. Contented	1	2	3	4
24. Tired	1	2	3	4
25. Impatient	1	2	3	4
26. Annoyed	1	2	3	4
27. Angry	1	2	3	4
28. Irritated	1	2	3	4
29. Grouchy	1	2	3	4

QSU-Brief Form

EVENING ASSESSMENT: Part 2 of 2

Instructions

*Indicate how much you agree or disagree with each of the following statements by circling the appropriate score on the scale below it, ranging from 1 (you **strongly disagree** with the statement above) to 7 (you **strongly agree** with the statement above). Please complete every item. We are interested in how you are thinking or feeling **right now** as you are filling out the questionnaire.*

1. I have a desire for a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

2. Nothing would be better than smoking a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

3. If it were possible, I probably would smoke now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

4. I could control things better right now if I could smoke.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

5. All I want right now is a cigarette.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

6. I have an urge for a cigarette.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

7. A cigarette would taste good now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

8. I would do almost anything for a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

9. Smoking would make me less depressed.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

10. I am going to smoke as soon as possible.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

BIG 5 (IPIP modification)

On the following pages, *there are phrases describing people's behaviours. Please use the rating scale below to describe how accurately each statement describes* ***you****. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Please read each statement carefully, and then circle the number that corresponds to the appropriate description on the scale.*

Response Options

1: Very Inaccurate

2: Moderately Inaccurate

3: Neither Inaccurate nor Accurate

4: Moderately Accurate

5: Very Accurate

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
I am the life of the party.	1	2	3	4	5
I feel little concern for others.	1	2	3	4	5
I am always prepared.	1	2	3	4	5
I get stressed out easily.	1	2	3	4	5
I have a rich vocabulary.	1	2	3	4	5
I don't talk a lot.	1	2	3	4	5
I am interested in people.	1	2	3	4	5
I leave my belongings around.	1	2	3	4	5
I am relaxed most of the time.	1	2	3	4	5
I have difficulty understanding abstract ideas.	1	2	3	4	5
I feel comfortable around people.	1	2	3	4	5
I insult people.	1	2	3	4	5
I pay attention to details.	1	2	3	4	5
I worry about things.	1	2	3	4	5
I have a vivid imagination.	1	2	3	4	5
I keep in the background.	1	2	3	4	5
I sympathise with others' feelings.	1	2	3	4	5
I make a mess of things.	1	2	3	4	5

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
I seldom feel blue.	1	2	3	4	5
I am not interested in abstract ideas.	1	2	3	4	5
I start conversations.	1	2	3	4	5
I am not interested in other people's problems.	1	2	3	4	5
I get chores done right away.	1	2	3	4	5
I am easily disturbed.	1	2	3	4	5
I have excellent ideas.	1	2	3	4	5
I have little to say.	1	2	3	4	5
I have a soft heart.	1	2	3	4	5
I often forget to put things back in their proper place.	1	2	3	4	5
I get upset easily.	1	2	3	4	5
I do not have a good imagination.	1	2	3	4	5
I talk to a lot of different people at parties.	1	2	3	4	5
I'm not really interested in others.	1	2	3	4	5
I like order.	1	2	3	4	5
I change my mood a lot.	1	2	3	4	5
I am quick to understand things.	1	2	3	4	5
I don't like to draw attention to myself.	1	2	3	4	5

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
I shirk my duties.	1	2	3	4	5
I take time out for others.	1	2	3	4	5
I have frequent mood swings.	1	2	3	4	5
I use difficult words.	1	2	3	4	5
I don't mind being the centre of attention.	1	2	3	4	5
I feel others' emotions.	1	2	3	4	5
I follow a schedule.	1	2	3	4	5
I get irritated easily.	1	2	3	4	5
I spend time reflecting on things.	1	2	3	4	5
I am quiet around strangers.	1	2	3	4	5
I make people feel at ease.	1	2	3	4	5
I am exacting in my work.	1	2	3	4	5
I often feel blue.	1	2	3	4	5
I am full of ideas.	1	2	3	4	5

BIS/BAS scale

Each item of this questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Circle the appropriate response option for each item.

	Very true for me	Somewhat true for me	Somewhat false for me	Very false for me
1. Even if something bad is about to happen to me, I rarely experience fear or nervousness.	1	2	3	4
2. I go out of my way to get things I want.	1	2	3	4
3. When I'm doing well at something I love to keep at it.	1	2	3	4
4. I'm always willing to try something new if I think it will be fun.	1	2	3	4
5. When I get something I want, I feel excited and energised.	1	2	3	4
6. Criticism or scolding hurts me quite a bit.	1	2	3	4
7. When I want something I usually go all-out to get it.	1	2	3	4
8. I will often do things for no other reason than that they might be fun.	1	2	3	4
9. If I see a chance to get something I want I move on it right away.	1	2	3	4
10. I feel pretty worried or upset when I think or know somebody is angry at me.	1	2	3	4
11. When I see an opportunity for something I like I get excited right away.	1	2	3	4
12. I often act on the spur of the moment.	1	2	3	4
13. If I think something unpleasant is going to happen I usually get pretty 'worked up'.	1	2	3	4
14. When good things happen to me, it affects me strongly.	1	2	3	4
15. I feel worried when I think I have done poorly at something important.	1	2	3	4
16. I crave excitement and new sensations.	1	2	3	4
17. When I go after something I use a 'no holds barred' approach.	1	2	3	4
18. I have very few fears compared to my friends.	1	2	3	4
19. It would excite me to win a contest.	1	2	3	4
20. I worry about making mistakes.	1	2	3	4

Information Sheet: The 48-hour monitoring period

This sheet provides some additional advice and instructions for using the diary materials (the Cigarette-diary sheets and Fixed-Interval Assessment Sheet) during your monitoring period.

During the monitoring period, you should complete the Fixed-Interval Assessment Sheet and the compact Cigarette-diary sheets. You will complete the Fixed-Interval Assessment Sheet by providing your responses on five separate occasions (in five separate columns), as prompted by the sheet. The number of Cigarette-diary sheets you complete is dependent on how many cigarettes you smoke; you should complete one sheet for each cigarette you smoke.

Fixed –Interval Assessment Sheet

At 8pm on the start date that you agreed with the researcher, you should complete the first (leftmost) column of the Fixed-Interval Assessment Sheet. This marks the start of your monitoring period. You should complete the subsequent fixed-interval assessments at the times stated. On completion of the fifth assessment column, your monitoring period will end.

If, for any of the fixed-interval assessments, you are unable to respond at the time stated, you should try to respond as close to the time as you can. This might mean completing an assessment slightly earlier than prompted if, for example, you are aware in advance that you may not have the opportunity to respond at, or just after, the stated time. It might also mean completing an assessment at the earliest opportunity *after* the stated time; if you are late in responding to a fixed-interval assessment for any reason, you should respond as soon as you are able. Do not leave any assessment columns blank.

When responding, you should write in every cell – if a statement does not fit your experiences, you should put a zero in the appropriate cell to represent this. Similarly, if you have not consumed any alcohol, coffee/tea, or spent any money on tobacco, you should indicate this in the appropriate cell.

Please refer to the instructions on the 'Fixed-Interval Assessment Sheet' for further guidance on completing the sheet.

Cigarette-diary sheets

Over the duration of the monitoring period, you should monitor your smoking episodes by completing both sides of a (double-sided) Cigarette-diary sheet for each cigarette you smoke. The sheets are compact enough to be kept with your cigarette packet, and you should keep at least as many sheets with you as cigarettes in your possession.

Although it is important that you complete the pre and post-smoking assessments as close in time to the smoking episode as possible, there may be some situations where it is not safe to do so. You should **always prioritise your safety** in such situations. For example, if you decide to smoke whilst driving a car, you should safely park your car in order to complete a Cigarette-diary sheet. You would need to park before and after smoking to complete the sheet, and should try to do this – safety permitting – as close to the smoking episode as possible (although delays in responding may be unavoidable).

The sheets allow you to specify the time that you actually smoke, as well as the time at which you begin to complete the corresponding diary sheet. This is so that we can tell when you have had to start a sheet after having actually smoked. If you have to start a sheet after you have smoked, you should fill in the pre- section to reflect your state before you smoked; **try to recall exactly how you felt**. Normally it will not be necessary to specify a separate smoking time, as you should be filling in the first side of the diary sheet immediately before you smoke.

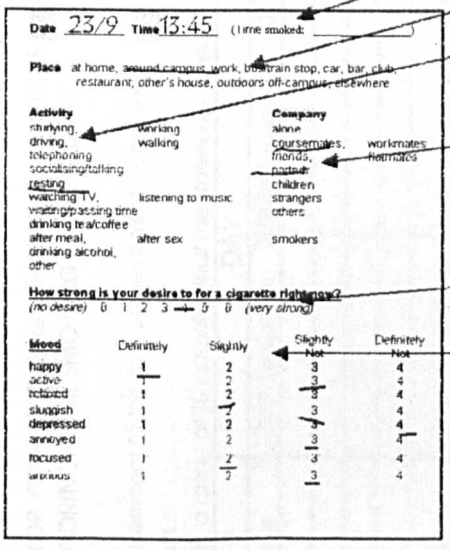
Try not to modify your smoking patterns during the monitoring period; it is important that you record your normal patterns of behaviour, as they would occur if you were not monitoring them.

Please refer to the A4 sheet entitled 'The Cigarette-diary Sheet' for further instruction on how the sheets should be completed.

The Cigarette-diary Sheet

For each cigarette you smoke during the 48-hour participation period, you should complete a cigarette-diary sheet. The diary sheet is compact enough to be kept with/inside your cigarette packet, so that it is more convenient for you to monitor your smoking episodes as they occur. The diary sheet is double-sided, with the first side of the sheet assessing your pre-smoking state, and the second side assessing your post-smoking state. You should complete the pre-smoking assessment immediately before you begin smoking, and the post-smoking assessment immediately after you have finished smoking.

For each cigarette you smoke, you should complete a cigarette-diary sheet as instructed below:



Date 23/9 Time 13:45 (Time smoked:)

Place at home, ~~around campus~~, work, train stop, car, bar, club, restaurant, other's house, outdoors off-campus, elsewhere

Activity
working, driving, telephoning, socialising/talking, resting, watching TV, waiting/passing time, drinking tea/coffee, after meal, drinking alcohol, other
walking, listening to music, after sex

Company
alone, coursemates, friends, partner, children, strangers, others, smokers
workmates, flatmates

How strong is your desire to for a cigarette right now?
(no desire) 0 1 2 3 4 5 6 *(very strong)*

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

This side of the cigarette-diary sheet should be completed immediately before you smoke the cigarette.

Please fill in the date (dd/mm) and time (e.g. 13:45/1.45pm) at the top of the page.

Underline or circle one of the options here to indicate *where* you are about to smoke. If you choose the "elsewhere" option, please specify your location in a convenient space on the sheet.

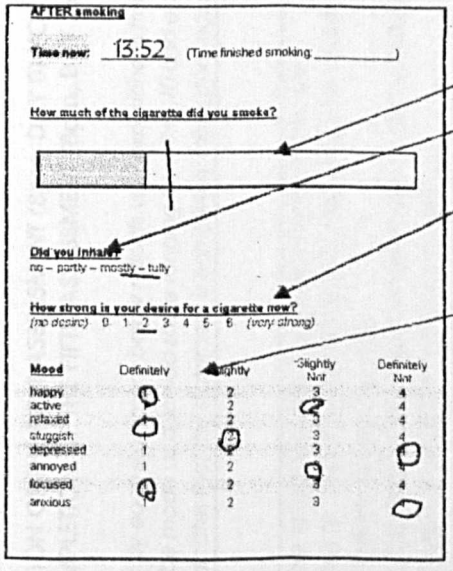
Underline or circle one or more of the options here to indicate *what* you are doing as you are about to smoke. In the example shown here, the participant has indicated that she is about to smoke a cigarette in a social situation. If you choose the "other" option, please specify your activity in a convenient space on the sheet.

Underline or circle **one or more** of the options here to indicate *who* you are with as you are about to smoke. In the example shown here, the participant is about to smoke in the presence of her partner and her course-mates. She has also underlined smokers to indicate that there is at least one other smoker in her present company. If you choose the "others" option, please specify the type of company in a convenient space on the sheet.

Indicate the extent of your desire for a cigarette here by circling or underlining the appropriate score on the scale, where 0 indicates that you have no real desire to smoke and 6 indicates that you have an intense desire to smoke.

This section of the sheet is concerned with your feelings prior to smoking. It presents a list of words that describe people's moods or feelings. Indicate how well each word describes how you are feeling. For each word, underline or circle the answer from 1 to 4 which best describes your mood.

Please answer, as honestly as you can, what is true of you. Also, be sure to answer according to how you feel **at the moment that you are giving your responses**. Don't just put down how you usually feel. Try and work quite quickly: the first answer you think of is usually best.



AFTER smoking

Time now: 13:52 (Time finished smoking:)

How much of the cigarette did you smoke?

Did you inhale?
no – partly – mostly – fully

How strong is your desire for a cigarette now?
(no desire) 0 1 2 3 4 5 6 *(very strong)*

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

This side of the cigarette-diary sheet should be completed immediately after you have smoked the cigarette.

Indicate how much of the cigarette you smoked by drawing a vertical line at the appropriate point on the cigarette diagram.

Underline or circle the appropriate option here to indicate the extent to which you inhaled when smoking the cigarette.

This question assesses the strength of your urge/desire to smoke immediately *after* you have smoked a cigarette. Indicate the extent of your desire for a cigarette here by circling or underlining the appropriate score on the scale, where 0 indicates that you have no real desire to smoke and 6 indicates that you have an overwhelming desire to smoke.

This section of the sheet is concerned with your feelings *after* smoking. It presents a list of words that describe people's moods or feelings. Indicate how well each word describes how you are feeling. For each word, underline or circle the answer from 1 to 4 which best describes your mood.

Please answer, as honestly as you can, what is true of you. Also, be sure to answer according to how you feel **at the moment that you are giving your responses**. Don't just put down how you usually feel. Try and work quite quickly: the first answer you think of is usually best.

This assessment sheet is to be completed five times over the course of the 48-hour diary period. In the first assessment (8pm, DAY 0), answer each section so as to reflect your experiences since 12pm of the same day. At other assessment intervals, you should answer so as to reflect your experiences since the previous assessment interval. For example, the second assessment (12pm, DAY 1) should reflect experiences between 8pm on DAY 0 and 12pm on DAY 1.

ON COMPLETION OF THE FIRST ASSESSMENT (8pm, DAY 0) YOU SHOULD BEGIN TO MONITOR YOUR SMOKING BEHAVIOUR USING THE CIGARETTE-DIARY SHEETS, AND ON COMPLETION OF THE FIFTH ASSESSMENT (8pm, DAY 2) YOU SHOULD STOP MONITORING YOUR SMOKING BEHAVIOUR.

Rate how truthfully each statement below reflects your experiences from the time of your previous assessment to the time of the current assessment.
Ratings should be made as a scaled score ranging from 0 to 10 and entered into the appropriate box.
A rating of 0 indicates that the statement is completely false (does not reflect your experiences at all), a rating of 10 indicates that the statement is very true of your experiences.

	DAY 0	DAY 1		DAY 2	
	8pm (actual time:)	12pm (actual time:)	8pm (actual time:)	12pm (actual time:)	8pm (actual time:)
"I've felt unable to control the important things in my life"					
"I've felt confident about my ability to handle personal problems"					
"I've felt things were going my way"					
"I've felt difficulties were piling up so high that I could not overcome them"					
"I've frequently felt an urge or desire to smoke"					
"The urges, or desires, to smoke that I've experienced have been weak"					
"The urges to smoke that I've experienced have been lasting a long time"					
"I've found it difficult to concentrate on what I've been doing"					
"I have found it easy to ignore potential distractions"					
"I've frequently been exposed to passive smoke"					
"Other people's smoke has been very noticeable"					
"I've not spent any time in smoky environments"					

Think back over the experiences you have had since the time of your previous assessment; over this time period:

What was the most pleasurable experience you had?					
Rate the pleasantness of this experience out of 10					
What was the least pleasurable experience you had?					
Rate the unpleasantness of this experience out of 10					

Think back over your behaviour since the time of your previous assessment; over this time period:

How many units of alcohol have you consumed?*					
How many cups of tea/coffee have you consumed?					

**Overleaf you will find a chart to assist you in calculating your alcohol consumption.*

Calculating Alcohol Consumption

This chart enables the calculation of units in any given bottle or can of beer, cider, wine or spirits. Just look down the left hand column until you come to the strength of the drink in question; then read along the line horizontally until you come to the relevant can, bottle or glass size. The figure shown is the total number of units in the container, rounded to the nearest manageable fraction.

%Alcohol by Volume	PUB MEASURES					BOTTLES AND CANS						
	Beer Cider 1/2 pint	Beer Cider 1pint	Spirits 1/8 gill	Ver-mouth 1/3 gill	Wine 125ml 4oz	Beer Cider 275ml	Beer Cider 330ml	Beer Cider 440ml	Wines Spirits 70cl	Wines Spirits Cider 75cl	Wines Spirits Beer Cider 1litre	
1%	1/4	1/2	-	-	-	1/4	1/3	1/2	2/3	3/4	1	Low alcohol wines & beers
3%	3/4	1 3/4	-	-	1/3	3/4	1	1 1/3	2	2 1/4	3	Low strength beers
31/2%	1	2	-	-	1/2	1	1 1/4	1 1/2	2 1/2	2 2/3	3 1/3	Standard strength beers & cider
4%	1	2 1/4	-	-	1/2	1	1 1/3	1 3/4	2 3/4	3	4	
41/2%	1 1/4	2 1/2	-	-	1/2	1 1/4	1 1/2	2	3 1/4	3 1/3	4 1/2	
5%	1 1/2	2 3/4	-	-	2/3	1 1/3	1 2/3	2 1/4	3 1/2	3 3/4	5	Export strength beers, strong ciders / Babycham
51/2%	1 1/2	3	-	-	2/3	1 1/2	1 3/4	2 1/2	3 3/4	4	5 1/2	
6%	1 3/4	3 1/2	-	-	3/4	1 2/3	2	2 2/3	4 1/4	4 1/2	6	
8%	2 1/4	4 1/2	-	-	1	2 1/4	2 2/3	3 1/2	5 1/2	6	8	Table wines / Super strength beers / Pomagne
9%	2 1/2	5	-	-	1	2 1/2	3	4	6 1/4	6 3/4	9	
10%	2 3/4	5 2/3	-	-	1 1/4	2 3/4	3 1/3	4 1/2	7	7 1/2	10	
11%	3	6 1/4	-	-	1 1/3	3	3 2/3	4 3/4	7 3/4	8 1/4	11	Barley wine
12%	-	-	-	-	1 1/2	-	-	-	8 1/2	9	12	
13%	-	-	-	-	1 2/3	-	-	-	9	9 3/4	13	
131/2%	-	-	-	-	1 2/3	-	-	-	9 1/2	10 1/4	13 1/2	Ginger wine, Montilla wine
141/2%	-	-	-	3/4	1 3/4	-	-	-	10 1/4	11	14 1/2	Vermouths, Sanatogen
15%	-	-	-	3/4	2	-	-	-	10 1/2	11 1/4	15	British sherry
17%	-	-	-	3/4	2	-	-	-	12	12 3/4	17	Cream liqeurs
171/2%	-	-	-	1	2 1/4	-	-	-	12 1/4	13	17 1/2	Sherry, Advocaat
20%	-	-	-	1	2 1/2	-	-	-	14	15	20	Port
24%	-	-	2/3	1 1/4	3	-	-	-	16 3/4	18	24	Cherry brandy, Campari, Malibu
25%	-	-	2/3	1 1/4	3	-	-	-	17 1/2	18 3/4	25	Pimms
261/2%	-	-	2/3	1 1/3	3 1/3	-	-	-	18 1/2	20	26 1/2	Liqeurs
371/2%	-	-	1	-	4 2/3	-	-	-	26 1/4	28	37 1/2	"Sub-norm" Spirits
40%	-	-	1	-	5	-	-	-	28	30	40	Standard Spirits
43%	-	-	1	-	5 1/3	-	-	-	30	32 1/4	43	"Import" Strength Spirits

Appendix B. Eating diary materials

Personal Information

Gender: ☐ Male ☐ Female (*Please tick as appropriate*)

Date of Birth: _____

The following questions gather information about your body mass history. Please write your answer to each question in the appropriate space, using a relevant unit of measurement: (cm) (ft in) (kg) (st lbs).

What is your current height? _____

What is your current weight? _____

What was your lowest adult weight? _____

What was your highest weight? _____

What do you consider to be your ideal weight? _____

Readiness for Dietary Change

In this context, attempts to diet are defined as any periods of time over which you adapt your food intake to achieve weight loss/health improvement.

How many serious attempts to diet have you made?

Total number _____

How strong is your current desire to diet?

Please indicate the extent of your desire to diet on the scale below. The scale ranges from 1 to 10, where 1 indicates that you have no desire to diet and 10 indicates that you have a very strong desire to diet.

1 (No desire) 2 3 4 5 6 7 8 9 10 (Very strong desire)

How confident are you in your ability to diet?

Please indicate the extent of your confidence in your ability to diet (if you were to decide that you wanted to diet) on the scale below. The scale ranges from 1 to 10, where 1 indicates that you have no confidence in your ability to diet and 10 indicates that you have absolute confidence in your ability to diet.

1 (No confidence) 2 3 4 5 6 7 8 9 10 (Absolute confidence)

How addicted to snacking do you perceive yourself to be?

Please indicate the extent to which you believe you are dependent on snacking on the scale below. The scale ranges from 1 to 10, where 1 indicates that, in your opinion, you are not at all addicted to snacking, and 10 indicates that, in your opinion, you are heavily addicted to snacking.

1 (Not at all) 2 3 4 5 6 7 8 9 10 (Heavily addicted)

How much do the people closest to you want you to diet? (*Please tick the appropriate box*)

☐ They want me to continue eating as I do presently
☐ They don't care one way or the other
☐ Somewhat
☐ Very much

MORNING ASSESSMENT: Please complete prior to lunch.

The assessment consists of 2 measures: the UWIST Mood Adjective Checklist and the QEU-Brief Form.

Take the assessment at a time when you are not eating.

Please do not complete this assessment immediately before or after eating.

Aim for a time when you have not recently eaten and are not preparing to eat imminently.

When you are ready to complete the 2 measures overleaf, enter the current time below.

TIME NOW: _____

UWIST Mood Adjective Checklist

MORNING ASSESSMENT: Part 1 of 2 (continues on next page)

Instructions

*This section of the questionnaire is concerned with your current feelings. Please answer **every** question, even if you find it difficult. Answer, as honestly as you can, what is true of **you**. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you feel **AT THE MOMENT**. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.*

*Here is a list of words that describe people's moods or feelings. Please indicate how well each word describes how you feel **AT THE MOMENT**. For each word, circle the answer from 1 to 4 which best describes your mood.*

	Definitely	Slightly	Slightly Not	Definitely Not
1. Happy	1	2	3	4
2. Dissatisfied	1	2	3	4
3. Energetic	1	2	3	4
4. Relaxed	1	2	3	4
5. Alert	1	2	3	4
6. Nervous	1	2	3	4
7. Passive	1	2	3	4
8. Cheerful	1	2	3	4
9. Tense	1	2	3	4
10. Jittery	1	2	3	4
11. Sluggish	1	2	3	4
12. Sorry	1	2	3	4
13. Composed	1	2	3	4
14. Depressed	1	2	3	4
15. Restful	1	2	3	4
16. Vigorous	1	2	3	4
17. Anxious	1	2	3	4
18. Satisfied	1	2	3	4
19. Unenterprising	1	2	3	4
20. Sad	1	2	3	4
21. Calm	1	2	3	4
22. Active	1	2	3	4
23. Contented	1	2	3	4
24. Tired	1	2	3	4
25. Impatient	1	2	3	4
26. Annoyed	1	2	3	4
27. Angry	1	2	3	4
28. Irritated	1	2	3	4
29. Grouchy	1	2	3	4

QEU-Brief Form

MORNING ASSESSMENT: Part 2 of 2

Instructions

*Indicate how much you agree or disagree with each of the following statements by circling the appropriate score on the scale below it, ranging from 1 (you **strongly disagree** with the statement above) to 7 (you **strongly agree** with the statement above). Please complete every item. We are interested in how you are thinking or feeling **right now** as you are filling out the questionnaire.*

1. I have a desire to eat right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

2. Nothing would be better than eating something right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

3. If it were possible, I probably would eat now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

4. I could control things better right now if I could eat.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

5. All I want right now is something to eat.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

6. I have an urge for something to eat.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

7. Eating would be enjoyable right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

8. I would do almost anything for some food right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

9. Eating would make me less depressed.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

10. I am going to eat as soon as possible.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

EVENING ASSESSMENT: Please complete in the evening.

The assessment consists of 2 measures: the UWIST Mood Adjective Checklist and the QEU-Brief Form.

Take the assessment at a time when you are not eating.

Please do not complete this assessment immediately before or after eating.

Aim for a time when you have not recently eaten and are not preparing to eat imminently.

When you are ready to complete the 2 measures overleaf, enter the current time below.

TIME NOW: _____

UWIST Mood Adjective Checklist

EVENING ASSESSMENT: Part 1 of 2 (continues on next page)

Instructions

*This section of the questionnaire is concerned with your current feelings. Please answer **every** question, even if you find it difficult. Answer, as honestly as you can, what is true of **you**. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you feel **AT THE MOMENT**. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.*

*Here is a list of words that describe people's moods or feelings. Please indicate how well each word describes how you feel **AT THE MOMENT**. For each word, circle the answer from 1 to 4 which best describes your mood.*

	Definitely	Slightly	Slightly Not	Definitely Not
1. Happy	1	2	3	4
2. Dissatisfied	1	2	3	4
3. Energetic	1	2	3	4
4. Relaxed	1	2	3	4
5. Alert	1	2	3	4
6. Nervous	1	2	3	4
7. Passive	1	2	3	4
8. Cheerful	1	2	3	4
9. Tense	1	2	3	4
10. Jittery	1	2	3	4
11. Sluggish	1	2	3	4
12. Sorry	1	2	3	4
13. Composed	1	2	3	4
14. Depressed	1	2	3	4
15. Restful	1	2	3	4
16. Vigorous	1	2	3	4
17. Anxious	1	2	3	4
18. Satisfied	1	2	3	4
19. Unenterprising	1	2	3	4
20. Sad	1	2	3	4
21. Calm	1	2	3	4
22. Active	1	2	3	4
23. Contented	1	2	3	4
24. Tired	1	2	3	4
25. Impatient	1	2	3	4
26. Annoyed	1	2	3	4
27. Angry	1	2	3	4
28. Irritated	1	2	3	4
29. Grouchy	1	2	3	4

QEU-Brief Form

EVENING ASSESSMENT: Part 2 of 2

Instructions

*Indicate how much you agree or disagree with each of the following statements by circling the appropriate score on the scale below it, ranging from 1 (you **strongly disagree** with the statement above) to 7 (you **strongly agree** with the statement above). Please complete every item. We are interested in how you are thinking or feeling **right now** as you are filling out the questionnaire.*

1. I have a desire to eat right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

2. Nothing would be better than eating something right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

3. If it were possible, I probably would eat now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

4. I could control things better right now if I could eat.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

5. All I want right now is something to eat.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

6. I have an urge for something to eat.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

7. Eating would be enjoyable right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

8. I would do almost anything for some food right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

9. Eating would make me less depressed.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

10. I am going to eat as soon as possible.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

THQ-Revised Form

Instructions

Indicate how much you agree or disagree with each of the following statements by circling the appropriate score on the scale below it. Please complete every item. We are interested in how you are thinking or feeling ***right now*** *as you are filling out the questionnaire.*

1. How hungry do you feel right now?

Not at all	1	2	3	4	5	6	7	**As hungry as I've ever felt**

2. How full does your stomach feel right now?

Not at all full	1	2	3	4	5	6	7	**Very full**

3. How strong is your desire to eat right now?

Very weak	1	2	3	4	5	6	7	**Very strong**

4. How much food do you think you could eat right now?

Nothing at all	1	2	3	4	5	6	7	**A large amount**

BIG 5 (IPIP modification)

On the following pages, *there are phrases describing people's behaviours. Please use the rating scale below to describe how accurately each statement describes* ***you****. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Please read each statement carefully, and then circle the number that corresponds to the appropriate description on the scale.*

Response Options

1: Very Inaccurate

2: Moderately Inaccurate

3: Neither Inaccurate nor Accurate

4: Moderately Accurate

5: Very Accurate

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
I am the life of the party.	1	2	3	4	5
I feel little concern for others.	1	2	3	4	5
I am always prepared.	1	2	3	4	5
I get stressed out easily.	1	2	3	4	5
I have a rich vocabulary.	1	2	3	4	5
I don't talk a lot.	1	2	3	4	5
I am interested in people.	1	2	3	4	5
I leave my belongings around.	1	2	3	4	5
I am relaxed most of the time.	1	2	3	4	5
I have difficulty understanding abstract ideas.	1	2	3	4	5
I feel comfortable around people.	1	2	3	4	5
I insult people.	1	2	3	4	5
I pay attention to details.	1	2	3	4	5
I worry about things.	1	2	3	4	5
I have a vivid imagination.	1	2	3	4	5
I keep in the background.	1	2	3	4	5
I sympathise with others' feelings.	1	2	3	4	5
I make a mess of things.	1	2	3	4	5

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
I seldom feel blue.	1	2	3	4	5
I am not interested in abstract ideas.	1	2	3	4	5
I start conversations.	1	2	3	4	5
I am not interested in other people's problems.	1	2	3	4	5
I get chores done right away.	1	2	3	4	5
I am easily disturbed.	1	2	3	4	5
I have excellent ideas.	1	2	3	4	5
I have little to say.	1	2	3	4	5
I have a soft heart.	1	2	3	4	5
I often forget to put things back in their proper place.	1	2	3	4	5
I get upset easily.	1	2	3	4	5
I do not have a good imagination.	1	2	3	4	5
I talk to a lot of different people at parties.	1	2	3	4	5
I'm not really interested in others.	1	2	3	4	5
I like order.	1	2	3	4	5
I change my mood a lot.	1	2	3	4	5
I am quick to understand things.	1	2	3	4	5
I don't like to draw attention to myself.	1	2	3	4	5

	Very Inaccurate	Moderately Inaccurate	Neither Inaccurate nor Accurate	Moderately Accurate	Very Accurate
I shirk my duties.	1	2	3	4	5
I take time out for others.	1	2	3	4	5
I have frequent mood swings.	1	2	3	4	5
I use difficult words.	1	2	3	4	5
I don't mind being the centre of attention.	1	2	3	4	5
I feel others' emotions.	1	2	3	4	5
I follow a schedule.	1	2	3	4	5
I get irritated easily.	1	2	3	4	5
I spend time reflecting on things.	1	2	3	4	5
I am quiet around strangers.	1	2	3	4	5
I make people feel at ease.	1	2	3	4	5
I am exacting in my work.	1	2	3	4	5
I often feel blue.	1	2	3	4	5
I am full of ideas.	1	2	3	4	5

BIS/BAS scale

Each item of this questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Circle the appropriate response option for each item.

	Very true for me	Somewhat true for me	Somewhat false for me	Very false for me
1. Even if something bad is about to happen to me, I rarely experience fear or nervousness.	1	2	3	4
2. I go out of my way to get things I want.	1	2	3	4
3. When I'm doing well at something I love to keep at it.	1	2	3	4
4. I'm always willing to try something new if I think it will be fun.	1	2	3	4
5. When I get something I want, I feel excited and energised.	1	2	3	4
6. Criticism or scolding hurts me quite a bit.	1	2	3	4
7. When I want something I usually go all-out to get it.	1	2	3	4
8. I will often do things for no other reason than that they might be fun.	1	2	3	4
9. If I see a chance to get something I want I move on it right away.	1	2	3	4
10. I feel pretty worried or upset when I think or know somebody is angry at me.	1	2	3	4
11. When I see an opportunity for something I like I get excited right away.	1	2	3	4
12. I often act on the spur of the moment.	1	2	3	4
13. If I think something unpleasant is going to happen I usually get pretty 'worked up'.	1	2	3	4
14. When good things happen to me, it affects me strongly.	1	2	3	4
15. I feel worried when I think I have done poorly at something important.	1	2	3	4
16. I crave excitement and new sensations.	1	2	3	4
17. When I go after something I use a 'no holds barred' approach.	1	2	3	4
18. I have very few fears compared to my friends.	1	2	3	4
19. It would excite me to win a contest.	1	2	3	4
20. I worry about making mistakes.	1	2	3	4

TFEQ scale

Each item of this questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Circle the appropriate response option for each item.

	Very true for me	Somewhat true for me	Somewhat false for me	Very false for me
1. I deliberately take small helpings as a means of controlling my weight.	1	2	3	4
2. Sometimes when I start eating, I just can't seem to stop.	1	2	3	4
3. I do not eat some foods because they make me fat.	1	2	3	4
4. I often avoid 'stocking up' on tempting foods.	1	2	3	4
5. When I feel anxious, I find myself eating.	1	2	3	4
6. When I smell food, I find it difficult to keep from eating, even if I have just finished a mea	1	2	3	4
7. I consciously hold back at meals in order not to gain weight.	1	2	3	4
8. When I feel blue, I often overeat.	1	2	3	4
9. I am always hungry enough to eat at any time.	1	2	3	4
10. I get so hungry that my stomach often feels like a bottomless pit.	1	2	3	4
11. I consciously eat less than I want.	1	2	3	4
12. I often feel hungry.	1	2	3	4
13. I eat whatever I want, whenever I want it.	1	2	3	4
14. I find it hard to stop eating before I finish the food on my plate.	1	2	3	4
15. When I feel lonely, I console myself by eating.	1	2	3	4
16. I go on eating binges though I am not hungry.	1	2	3	4
17. Being with someone who is eating often makes me hungry enough to eat also.	1	2	3	4
18. I am constantly limiting my food intake and never 'giving in'.	1	2	3	4
19. When I see a real delicacy, I often get so hungry that I have to eat right away.	1	2	3	4

Information Sheet: The 48-hour monitoring period

This sheet provides some additional advice and instructions for using the diary materials (the Snack-diary sheets and Fixed-Interval Assessment Sheet) during your monitoring period.

During the monitoring period, you should complete the Fixed-Interval Assessment Sheet and the compact Snack-diary sheets. You will complete the Fixed-Interval Assessment Sheet by providing your responses on five separate occasions (in five separate columns), as prompted by the sheet. The number of Snack-diary sheets you complete is dependent on how many snacks/meals you consume; you should complete one sheet for each snack or meal that you eat.

Fixed-Interval Assessment Sheet

At 8pm on the start date that you agreed with the researcher, you should complete the first (leftmost) column of the Fixed-Interval Assessment Sheet. This marks the start of your monitoring period. You should complete the subsequent fixed-interval assessments at the times stated. On completion of the fifth assessment column, your monitoring period will end.

If, for any of the fixed-interval assessments, you are unable to respond at the time stated, you should try to respond as close to the time as you can. This might mean completing an assessment slightly earlier than prompted if, for example, you are aware in advance that you may not have the opportunity to respond at, or just after, the stated time. It might also mean completing an assessment at the earliest opportunity *after* the stated time; if you are late in responding to a fixed-interval assessment for any reason, you should respond as soon as you are able. Do not leave any assessment columns blank.

When responding, you should write in every cell – if a statement does not fit your experiences, you should put a zero in the appropriate cell to represent this. Similarly, if you have not consumed any alcohol or coffee/tea you should indicate this in the appropriate cell.

Please refer to the instructions on the 'Fixed-Interval Assessment Sheet' for further guidance on completing the sheet.

Snack-diary sheets

Over the duration of the monitoring period, you should monitor your eating episodes by completing both sides of a (double-sided) Snack-diary sheet for each snack/meal you eat. The sheets are compact enough to be kept on your person, and you should keep at least as many sheets with you as the maximum number of eating episodes you expect to occur.

Although it is important that you complete the pre and post-eating assessments as close in time to the eating episode as possible, there may be some situations where it is not safe to do so. You should **always prioritise your safety** in such situations. For example, if you decide to eat whilst driving a car, you should safely park your car in order to complete a Snack-diary sheet. You would need to park before and after eating to complete the sheet, and should try to do this – safety permitting – as close to the snacking episode as possible (although delays in responding may be unavoidable).

The sheets allow you to specify the time that you actually eat, as well as the time at which you begin to complete the corresponding diary sheet. This is so that we can tell when you have had to start a sheet after having actually eaten. If you have to start a sheet after you have eaten, you should fill in the pre- section to reflect your state before you ate; **try to recall exactly how you felt**. Normally it will not be necessary to specify a separate eating time, as you should be filling in the first side of the diary sheet immediately before you eat each snack.

Try not to modify your eating patterns during the monitoring period; it is important that you record your normal patterns of behaviour, as they would occur if you were not monitoring them.

Please refer to the A4 sheet entitled 'The Snack-diary Sheet' for further instruction on how the sheets should be completed.

Fixed Interval Assessment Sheet

This assessment sheet is to be completed five times over the course of the 48-hour dairy period. In the first assessment (8pm, DAY 0), answer each section so as to reflect your experiences since 12pm of the same day. At other assessment intervals, you should answer so as to reflect your experiences since the previous assessment interval. For example, the second assessment (12pm, DAY 1) should reflect experiences between 8pm on DAY 0 and 12pm on DAY 1.

ON COMPLETION OF THE FIRST ASSESSMENT (8pm, DAY 0) YOU SHOULD BEGIN TO MONITOR YOUR SNACKING BEHAVIOUR USING THE SNACK-DIARY SHEETS, AND ON COMPLETION OF THE FIFTH ASSESSMENT (8pm, DAY 2) YOU SHOULD STOP MONITORING YOUR SNACKING BEHAVIOUR.

Rate how truthfully each statement below reflects your experiences from the time of your previous assessment to the time of the current assessment.
Ratings shoud be made on a scale ranging from 0 to 10 and entered into the appropriate box.
A rating of 0 indicates that the statement is completely false (does not reflect your experiences at all), a rating of 10 indicates that the statement is very true of your experiences.

	DAY 0	DAY 1		DAY 2	
	8pm (actual time:)	12pm (actual time:)	8pm (actual time:)	12pm (actual time:)	8pm (actual time:)
"I've felt unable to control the important things in my life"					
"I've felt confident about my ability to handle personal problems"					
"I've felt things were going my way"					
"I've felt difficulties were piling up so high that I could not overcome them"					
"I've frequently felt hungry (an urge or desire to eat)"					
"The urges, or desires, to eat that I've experienced have been weak"					
"The urges to eat that I've experienced have been lasting a long time"					
"I've found it difficult to concentrate on what I've been doing"					
"I have found it easy to ignore potential distractions"					
"I've frequently been around other people eating"					
"I've been very aware that other people are eating"					
"I've not spent any time in environments where others are eating"					

Think back over the experiences you have had since the time of your previous assessment; over this time period:

What was the most pleasurable experience you had?					
Rate the pleasantness of this experience out of 10					
What was the least pleasurable experience you had?					
Rate the unpleasantness of this experience out of 10					

Think back over your behaviour since the time of your previous assessment; over this time period:

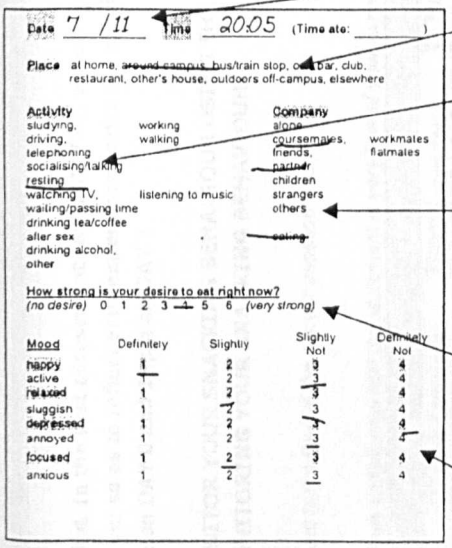
How many units of alcohol have you consumed?*					
How many cups of tea/coffee have you consumed?					

**Overleaf you will find a chart to assist you in calculating your alcohol consumption.*

The Snack-diary Sheet

For each snack or meal that you eat during the 48-hour participation period, you should complete a snack-diary sheet. The diary sheet is compact enough to be kept on your person, so that it is more convenient for you to monitor your eating episodes as they occur. The diary sheet is double-sided, with the first side of the sheet assessing your pre-eating state, and the second side assessing your post-eating state. You should complete the pre-eating assessment immediately before you eat the snack or meal and the post-eating assessment immediately after you have finished eating.

For each snack/meal you consume, you should complete a snack-diary sheet:



Date 7 /11 Time 20:05 (Time ate: _____)

Place at home, ~~around campus~~, bus/train stop, ~~cafe~~ bar, club, restaurant, other's house, outdoors off-campus, elsewhere

Activity
studying, working
driving, walking
telephoning
~~socialising/talking~~
resting
watching TV, listening to music
waiting/passing time
drinking tea/coffee
~~alter sex~~
drinking alcohol,
other

Company
~~alone~~
coursemates, workmates
friends, flatmates
~~partner~~
children
strangers
others
~~eating~~

How strong is your desire to eat right now?
(no desire) 0 1 2 3 ~~4~~ 5 6 *(very strong)*

Mood	Definitely	Slightly	Slightly Not	Definitely Not
~~happy~~	~~1~~	~~2~~	~~3~~	~~4~~
active	1	2	3	4
~~relaxed~~	1	2	~~3~~	4
sluggish	1	2	3	4
~~depressed~~	1	2	~~3~~	~~4~~
annoyed	1	2	3	4
~~focused~~	1	2	~~3~~	4
anxious	1	2	3	4

This side of the snack-diary sheet should be completed immediately before you eat the snack/meal.

Please fill in the date (dd/mm) and time (e.g. 13:45/1.45pm) at the top of the page.

Underline or circle one of the options here to indicate *where* you are about to eat. If you choose the "elsewhere" option, please specify your location in a convenient space on the sheet.

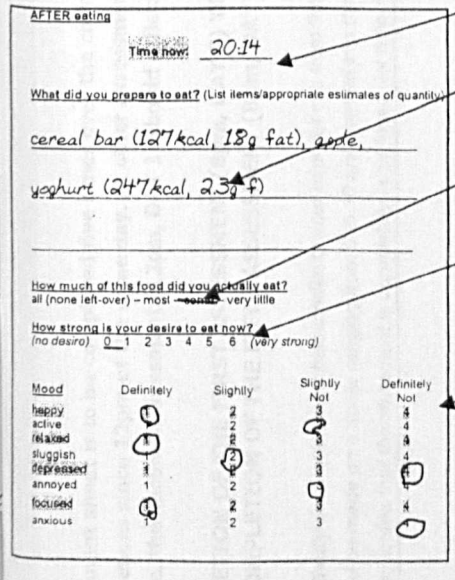
Underline or circle **one or more** of the options here to indicate *what* you are doing as you are about to eat. In the example shown here, the participant has indicated that she is about to eat a snack whilst resting. If you choose the "other" option, please specify your activity in a convenient space on the sheet.

Underline or circle **one or more** of the options here to indicate *who* you are with as you are about to eat. In the example shown here, the participant is about to smoke in the presence of her partner and her course-mates. She has also underlined eating to indicate that there is at least one other person in her present company who is also eating. If you choose the "others" option, please specify the type of company in a convenient space on the sheet.

Indicate the intensity of your hunger here by circling or underlining the appropriate score on the scale, where 0 indicates that you have no real desire to eat and 6 indicates that you have an intense desire to eat.

This section of the sheet is concerned with your feelings prior to eating. It presents a list of words that describe people's moods or feelings. Indicate how well each word describes how you are feeling. For each word, underline or circle the answer from 1 to 4 which best describes your mood.

Please answer, as honestly as you can, what is true of **you**. Also, be sure to answer according to how you feel **at the moment that you are giving your responses**. Don't just put down how you usually feel. Try and work quite quickly: the first answer you think of is usually best.



AFTER eating

Time now: 20:14

What did you prepare to eat? (List items/appropriate estimates of quantity)

cereal bar (127kcal, 18g fat), apple,

yoghurt (247kcal, 2.3g f)

How much of this food did you actually eat?
all (none left-over) – most – ~~some~~ – very little

How strong is your desire to eat now?
(no desire) 0 1 2 3 4 5 6 *(very strong)*

Mood	Definitely	Slightly	Slightly Not	Definitely Not
~~happy~~	1	2	3	4
active	1	2	3	4
~~relaxed~~	1	2	3	4
sluggish	1	2	3	4
~~depressed~~	1	2	3	4
annoyed	1	2	3	4
~~focused~~	1	2	3	4
anxious	1	2	3	4

This side of the snack-diary sheet should be completed immediately after you have finished eating.

Please fill in the present time at the top of the page.

List the items that you prepared to eat here. Please record the approximate values of calorific and fat content after each item (where possible). In the example shown here, the participant has indicated that the cereal bar she prepared to eat contained 127 calories and 1.8 grams of fat.

Underline or circle the appropriate option here to indicate the extent to which you consumed the food you had prepared. In the example here, the participant only ate some of the food she had intended to.

This question assesses the strength of your urge/desire to eat immediately *after* you have eaten a snack. Indicate the intensity of your hunger here by circling or underlining the appropriate score on the scale, where 0 indicates that you have no real desire to eat and 6 indicates that you have an overwhelming desire to eat.

This section of the sheet is concerned with your feelings *after* eating. It presents a list of words that describe people's moods or feelings. Indicate how well each word describes how you are feeling. For each word, underline or circle the answer from 1 to 4 which best describes your mood.

Please answer, as honestly as you can, what is true of **you**. Also, be sure to answer according to how you feel **at the moment that you are giving your responses**. Don't just put down how you usually feel. Try and work quite quickly: the first answer you think of is usually best.

Calculating Alcohol Consumption

This chart enables the calculation of units in any given bottle or can of beer, cider, wine or spirits. Just look down the left hand column until you come to the strength of the drink in question; then read along the line horizontally until you come to the relevant can, bottle or glass size. The figure shown is the total number of units in the container, rounded to the nearest manageable fraction.

%Alcohol by Volume	PUB MEASURES					BOTTLES AND CANS						
	Beer Cider 1/2 pint	Beer Cider 1pint	Spirits 1/8 gill	Ver-mouth 1/3 gill	Wine 125ml 4oz	Beer Cider 275ml	Beer Cider 330ml	Beer Cider 440ml	Wines Spirits 70cl	Wines Spirits Cider 75cl	Wines Spirits Beer Cider 1litre	
1%	1/4	1/2	-	-	-	1/4	1/3	1/2	2/3	3/4	1	Low alcohol wines & beers
3%	3/4	1 3/4	-	-	1/3	3/4	1	1 1/3	2	2 1/4	3	Low strength beers
31/2%	1	2	-	-	1/2	1	1 1/4	1 1/2	2 1/2	2 2/3	3 1/3	Standard strength beers & cider
4%	1	2 1/4	-	-	1/2	1	1 1/3	1 3/4	2 3/4	3	4	
41/2%	1 1/4	2 1/2	-	-	1/2	1 1/4	1 1/2	2	3 1/4	3 1/3	4 1/2	
5%	1 1/2	2 3/4	-	-	2/3	1 1/3	1 2/3	2 1/4	3 1/2	3 3/4	5	Export strength beers, strong ciders / Babycham
51/2%	1 1/2	3	-	-	2/3	1 1/2	1 3/4	2 1/2	3 3/4	4	5 1/2	
6%	1 3/4	3 1/2	-	-	3/4	1 2/3	2	2 2/3	4 1/4	4 1/2	6	
8%	2 1/4	4 1/2	-	-	1	2 1/4	2 2/3	3 1/2	5 1/2	6	8	Table wines / Super strength beers / Pomagne
9%	2 1/2	5	-	-	1	2 1/2	3	4	6 1/4	6 3/4	9	
10%	2 3/4	5 2/3	-	-	1 1/4	2 3/4	3 1/3	4 1/2	7	7 1/2	10	
11%	3	6 1/4	-	-	1 1/3	3	3 2/3	4 3/4	7 3/4	8 1/4	11	Barley wine
12%	-	-	-	-	1 1/2	-	-	-	8 1/2	9	12	
13%	-	-	-	-	1 2/3	-	-	-	9	9 3/4	13	
131/2%	-	-	-	-	1 2/3	-	-	-	9 1/2	10 1/4	13 1/2	Ginger wine, Montilla wine
141/2%	-	-	-	3/4	1 3/4	-	-	-	10 1/4	11	14 1/2	Vermouths, Sanatogen
15%	-	-	-	3/4	2	-	-	-	10 1/2	11 1/4	15	British sherry
17%	-	-	-	3/4	2	-	-	-	12	12 3/4	17	Cream liqeurs
171/2%	-	-	-	1	2 1/4	-	-	-	12 1/4	13	17 1/2	Sherry, Advocaat
20%	-	-	-	1	2 1/2	-	-	-	14	15	20	Port
24%	-	-	2/3	1 1/4	3	-	-	-	16 3/4	18	24	Cherry brandy, Campari, Malibu
25%	-	-	2/3	1 1/4	3	-	-	-	17 1/2	18 3/4	25	Pimms
261/2%	-	-	2/3	1 1/3	3 1/3	-	-	-	18 1/2	20	26 1/2	Liqeurs
371/2%	-	-	1	-	4 2/3	-	-	-	26 1/4	28	37 1/2	"Sub-norm" Spirits
40%	-	-	1	-	5	-	-	-	28	30	40	Standard Spirits
43%	-	-	1	-	5 1/3	-	-	-	30	32 1/4	43	"Import" Strength Spirits

Appendix C. Quasi-interventional diary materials

The initial assessment was the same as that administered in the original smoking diary (Appendix A), and is not shown again here.

Information Sheet: The 72-hour monitoring period

This sheet provides some additional advice and instructions for using the diary materials (the Cigarette-diary sheets and Fixed-Interval Assessment Sheets) during your monitoring period.

During the monitoring period, you should complete the Fixed-Interval Assessment Sheets (1 and 2) and the compact Cigarette-diary sheets. You will complete the Fixed-Interval Assessment Sheets by providing your responses on seven separate occasions (in seven separate columns/sections), as prompted by the sheets. The number of Cigarette-diary sheets you complete is dependent on how many cigarettes you smoke; you should complete one sheet for each cigarette you smoke.

Fixed –Interval Assessment Sheet 1

At 8pm on the start date that you agreed with the researcher, you should complete the first (leftmost) column of the Fixed-Interval Assessment Sheet. This marks the start of your monitoring period. You should complete the subsequent fixed-interval assessments at the times stated. On completion of the seventh assessment column, your monitoring period will end.

If, for any of the fixed-interval assessments, you are unable to respond at the time stated, you should try to respond as close to the time as you can. This might mean completing an assessment slightly earlier than prompted if, for example, you are aware in advance that you may not have the opportunity to respond at, or just after, the stated time. It might also mean completing an assessment at the earliest opportunity *after* the stated time; if you are late in responding to a fixed-interval assessment for any reason, you should respond as soon as you are able. Do not leave any assessment columns blank.

When responding, you should write in every cell – if a statement does not fit your experiences, you should put a zero in the appropriate cell to represent this. Similarly, if you have not consumed any alcohol or coffee/tea, you should indicate this in the appropriate cell.

Please refer to the instructions on the 'Fixed-Interval Assessment Sheet 1' for further guidance on completing the sheet.

Fixed –Interval Assessment Sheet 2

Every time you complete an assessment column on Fixed-Interval Assessment Sheet 1 you should immediately go on to complete the corresponding assessment of mood and urge to smoke on Fixed-Interval Assessment Sheet 2.

These measures pertain to your present feelings (at the time you are completing each assessment), you should **not** be thinking back over your experiences as you did for Fixed -Interval Assessment Sheet 1.

Please refer to the instructions on the 'Fixed-Interval Assessment Sheet 2' for further guidance on completing the sheet.

Cigarette-diary sheets

Over the duration of the monitoring period, you should monitor your smoking episodes by completing both sides of a (double-sided) Cigarette-diary sheet for each cigarette you smoke. The sheets are compact enough to be kept on your person/with your cigarette packet, and you should keep at least as many sheets with you as cigarettes.

Although it is important that you complete the pre and post-smoking assessments as close in time to the smoking episode as possible, there may be some situations where it is not safe to do so. You should **always prioritise your safety** in such situations. For example, if you decide to smoke whilst driving a car, you should safely park your car in order to complete a Cigarette-diary sheet. You would need to park before and after smoking to complete the sheet, and should try to do this – safety permitting – as close to the smoking episode as possible (although delays in responding may be unavoidable).

The sheets allow you to specify the time that you actually smoke, as well as the time at which you begin to complete the corresponding diary sheet. This is so that we can tell when you have had to start a sheet after having actually smoked. If you have to start a sheet after you have smoked, you should fill in the pre- section to reflect your state before you smoked; **try to recall exactly how you felt.** Normally it will not be necessary to specify a separate smoking time, as you should be filling in the first side of the diary sheet immediately before you smoke each cigarette.

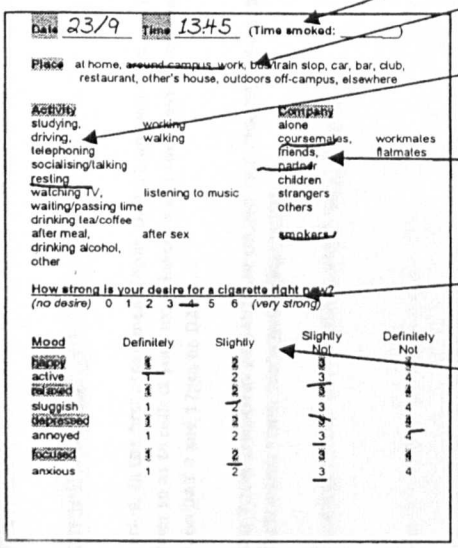
Try not to modify your smoking patterns during the monitoring period before you are asked to attempt abstinence; it is important that you record your normal patterns of behaviour, as they would occur if you were not monitoring them. During the abstinence period you are encouraged to refrain from smoking, but, if you do smoke during this period, please monitor each episode using the cigarette-diary sheets as before. **Please prioritise honesty over compliance.** After the phase of encouraged abstinence you will go on monitoring your smoking episodes (if/when they occur) for a further 24 hours. You are not explicitly encouraged to abstain during this final phase of monitoring, but neither are you encouraged to smoke; you should behave as you would if you were no longer participating in the study.

Please refer to the A4 sheet entitled 'The Cigarette-diary Sheet' for further instruction on how the sheets should be completed.

The Cigarette-diary Sheet

For each cigarette you smoke during the 72-hour participation period, you should complete a cigarette-diary sheet. The diary sheet is compact enough to be kept with/inside your cigarette packet, so that it is more convenient for you to monitor your smoking episodes as they occur. The diary sheet is double-sided, with the first side of the sheet assessing your pre-smoking state, and the second side assessing your post-smoking state. You should complete the pre-smoking assessment immediately before you begin smoking, and the post-smoking assessment immediately after you have finished smoking.

For each cigarette you smoke, you should complete a cigarette-diary sheet as instructed below:


Date 23/9 Time 13:45 (Time smoked: _____)

Place at home, ~~around campus, work~~, bus/train stop, car, bar, club, restaurant, other's house, outdoors off-campus, elsewhere

Activity
studying, working
driving, walking
telephoning
socialising/talking
resting
watching TV, listening to music
waiting/passing time
drinking tea/coffee
after meal, after sex
drinking alcohol,
other

Company
alone
coursemates, workmates
friends, flatmates
partner
children
strangers
others
smokers

How strong is your desire for a cigarette right now?
(no desire) 0 1 2 3 4 5 6 (very strong)

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

This side of the cigarette-diary sheet should be completed immediately before you smoke the cigarette.

Please fill in the date (dd/mm) and time (e.g. 13:45/1.45pm) at the top of the page.

Underline or circle one of the options here to indicate *where* you are about to smoke. If you choose the "elsewhere" option, please specify your location in a convenient space on the sheet.

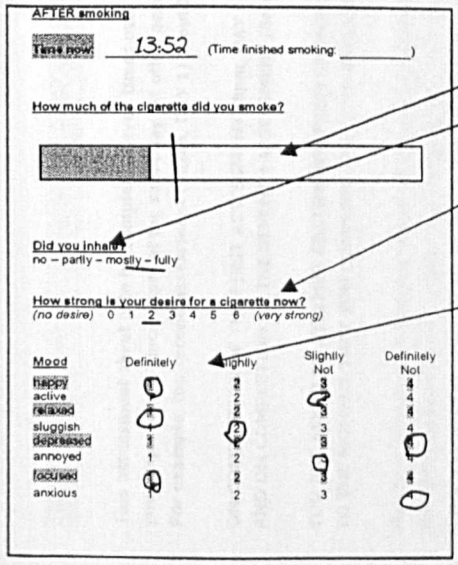
Underline or circle **one or more** of the options here to indicate *what* you are doing as you are about to smoke. In the example shown here, the participant has indicated that she is about to smoke a cigarette in a social situation. If you choose the "other" option, please specify your activity in a convenient space on the sheet.

Underline or circle **one or more** of the options here to indicate *who* you are with as you are about to smoke. In the example shown here, the participant is about to smoke in the presence of her partner and her course-mates. She has also underlined smokers to indicate that there is at least one other smoker in her present company. If you choose the "others" option, please specify the type of company in a convenient space on the sheet.

Indicate the extent of your desire for a cigarette here by circling or underlining the appropriate score on the scale, where 0 indicates that you have no real desire to smoke and 6 indicates that you have an intense desire to smoke.

This section of the sheet is concerned with your feelings prior to smoking. It presents a list of words that describe people's moods or feelings. Indicate how well each word describes how you are feeling. For each word, underline or circle the answer from 1 to 4 which best describes your mood.

Please answer, as honestly as you can, what is true of **you**. Also, be sure to answer according to how you feel **at the moment that you are giving your responses**. Don't just put down how you usually feel. Try and work quite quickly: the first answer you think of is usually best.


AFTER smoking

Time now: 13:52 (Time finished smoking: _____)

How much of the cigarette did you smoke?

Did you inhale?
no – partly – mostly – fully

How strong is your desire for a cigarette now?
(no desire) 0 1 2 3 4 5 6 (very strong)

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

This side of the cigarette-diary sheet should be completed immediately after you have smoked the cigarette.

Indicate how much of the cigarette you smoked by drawing a vertical line at the appropriate point on the cigarette diagram.

Underline or circle the appropriate option here to indicate the extent to which you inhaled when smoking the cigarette.

This question assesses the strength of your urge/desire to smoke immediately *after* you have smoked a cigarette. Indicate the extent of your desire for a cigarette here by circling or underlining the appropriate score on the scale, where 0 indicates that you have no real desire to smoke and 6 indicates that you have an overwhelming desire to smoke.

This section of the sheet is concerned with your feelings *after* smoking. It presents a list of words that describe people's moods or feelings. Indicate how well each word describes how you are feeling. For each word, underline or circle the answer from 1 to 4 which best describes your mood.

Please answer, as honestly as you can, what is true of **you**. Also, be sure to answer according to how you feel **at the moment that you are giving your responses**. Don't just put down how you usually feel. Try and work quite quickly: the first answer you think of is usually best.

Fixed Interval Assessment Sheet 1

This assessment sheet is to be completed seven times over the course of the 72-hour diary period. In the first assessment (8pm, DAY 0), answer each section so as to reflect your experiences since 12pm of the same day. At other assessment intervals, you should answer so as to reflect your experiences since the previous assessment interval. For example, the second assessment (12pm, DAY 1) should reflect experiences between 8pm on DAY 0 and 12pm on DAY 1.

ON COMPLETION OF THE FIRST ASSESSMENT (8pm, DAY 0) YOU SHOULD BEGIN TO MONITOR YOUR SMOKING BEHAVIOUR USING THE CIGARETTE-DIARY SHEETS, AND ON COMPLETION OF THE SEVENTH ASSESSMENT (8pm, DAY 3) YOU SHOULD STOP MONITORING YOUR SMOKING BEHAVIOUR.

YOU ARE ASKED TO ATTEMPT ABSTINENCE FROM SMOKING FROM THE MOMENT THAT YOU COMPLETE THE THIRD ASSESSMENT (8pm, DAY 1) TO THE MOMENT THAT YOU COMPLETE THE FIFTH ASSESSMENT (8pm, DAY 2)

Rate how truthfully each statement below reflects your experiences from the time of your previous assessment to the time of the current assessment.
Ratings should be made as a scaled score ranging from 0 to 10 and entered into the appropriate box.
A rating of 0 indicates that the statement is completely false (does not reflect your experiences at all), a rating of 10 indicates that the statement is very true of your experiences.

	DAY 0	DAY 1		DAY 2	
	8pm (actual time:)	12pm (actual time:)	8pm (actual time:)	12pm (actual time:)	8pm (actual time:)
"I've felt unable to control the important things in my life"					
"I've felt confident about my ability to handle personal problems"					
"I've felt things were going my way"					
"I've felt difficulties were piling up so high that I could not overcome them"					
"I've frequently felt an urge or desire to smoke"					
"The urges, or desires, to smoke that I've experienced have been weak"					
"The urges to smoke that I've experienced have been lasting a long time"					
"I've found it difficult to concentrate on what I've been doing"					
"I have found it easy to ignore potential distractions"					
"I've frequently been exposed to passive smoke"					
"Other people's smoke has been very noticeable"					
"I've not spent any time in smoky environments"					

Think back over the experiences you have had since the time of your previous assessment; over this time period:

What was the most pleasurable experience you had?					
Rate the pleasantness of this experience out of 10					
What was the least pleasurable experience you had?					
Rate the unpleasantness of this experience out of 10					

Think back over your behaviour since the time of your previous assessment; over this time period:

How many units of alcohol have you consumed?*					
How many cups of tea/coffee have you consumed?					

BEGIN MONITORING **BEGIN ABSTAINING** **(END ABSTAINING)**

Please turn over for assessments 6 and 7 (DAY 3)

Fixed Interval Assessment Sheet 1 (b)

This assessment sheet is to be completed seven times over the course of the 72-hour diary period. In the first assessment (8pm, DAY 0), answer each section so as to reflect your experiences since 12pm of the same day. At other assessment intervals, you should answer so as to reflect your experiences since the previous assessment interval. For example, the second assessment (12pm, DAY 1) should reflect experiences between 8pm on DAY 0 and 12pm on DAY 1.

ON COMPLETION OF THE FIRST ASSESSMENT (8pm, DAY 0) YOU SHOULD BEGIN TO MONITOR YOUR SMOKING BEHAVIOUR USING THE CIGARETTE-DIARY SHEETS, AND ON COMPLETION OF THE SEVENTH ASSESSMENT (8pm, DAY 3) YOU SHOULD STOP MONITORING YOUR SMOKING BEHAVIOUR.

YOU ARE ASKED TO ATTEMPT ABSTINENCE FROM SMOKING FROM THE MOMENT THAT YOU COMPLETE THE THIRD ASSESSMENT (8pm, DAY 1) TO THE MOMENT THAT YOU COMPLETE THE FIFTH ASSESSMENT (8pm, DAY 2)

Rate how truthfully each statement below reflects your experiences from the time of your previous assessment to the time of the current assessment.
Ratings should be made as a scaled score ranging from 0 to 10 and entered into the appropriate box.
A rating of 0 indicates that the statement is completely false (does not reflect your experiences at all), a rating of 10 indicates that the statement is very true of your experiences.

	DAY 3	
	12pm (actual time:)	8pm (actual time:)
"I've felt unable to control the important things in my life"		
"I've felt confident about my ability to handle personal problems"		
"I've felt things were going my way"		
"I've felt difficulties were piling up so high that I could not overcome them"		
"I've frequently felt an urge or desire to smoke"		
"The urges, or desires, to smoke that I've experienced have been weak"		
"The urges to smoke that I've experienced have been lasting a long time"		
"I've found it difficult to concentrate on what I've been doing"		
"I have found it easy to ignore potential distractions"		
"I've frequently been exposed to passive smoke"		
"Other people's smoke has been very noticeable"		
"I've not spent any time in smoky environments"		

Think back over the experiences you have had since the time of your previous assessment; over this time period:

What was the most pleasurable experience you had?		
Rate the pleasantness of this experience out of 10		
What was the least pleasurable experience you had?		
Rate the unpleasantness of this experience out of 10		

Think back over your behaviour since the time of your previous assessment; over this time period:

How many units of alcohol have you consumed?*		
How many cups of tea/coffee have you consumed?		

END MONITORING

*The attached chart will assist you in calculating your alcohol consumption.

Fixed Interval Assessment Sheet 2

This Fixed Interval Assessment Sheet is concerned with your feelings and desire to smoke *at each interval*.

Mood Form Instructions The Mood Form presents a list of words that describe people's moods or feelings. Indicate how well each word describes how you are feeling. For each word, underline or circle the answer from 1 to 4 which best describes your mood right now.

Desire Scale Instructions Indicate the extent of your desire for a cigarette right now by circling or underlining the appropriate score on the scale. 0 indicates that you have no real desire to smoke and 6 indicates that you have an overwhelming desire to smoke.

Day 0 8pm

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

How strong is your desire for a cigarette now?

(no desire) 0 1 2 3 4 5 6 *(very strong)*

Day 1 12pm

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

How strong is your desire for a cigarette now?

(no desire) 0 1 2 3 4 5 6 *(very strong)*

Day 1 8pm

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

How strong is your desire for a cigarette now?

(no desire) 0 1 2 3 4 5 6 *(very strong)*

Day 2 12pm

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

How strong is your desire for a cigarette now?

(no desire) 0 1 2 3 4 5 6 *(very strong)*

Day 2 8pm

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

How strong is your desire for a cigarette now?

(no desire) 0 1 2 3 4 5 6 *(very strong)*

Day 3 12pm

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

How strong is your desire for a cigarette now?

(no desire) 0 1 2 3 4 5 6 *(very strong)*

Day 3 8pm

Mood	Definitely	Slightly	Slightly Not	Definitely Not
happy	1	2	3	4
active	1	2	3	4
relaxed	1	2	3	4
sluggish	1	2	3	4
depressed	1	2	3	4
annoyed	1	2	3	4
focused	1	2	3	4
anxious	1	2	3	4

How strong is your desire for a cigarette now?

(no desire) 0 1 2 3 4 5 6 *(very strong)*

Calculating Alcohol Consumption

This chart enables the calculation of units in any given bottle or can of beer, cider, wine or spirits. Just look down the left hand column until you come to the strength of the drink in question; then read along the line horizontally until you come to the relevant can, bottle or glass size. The figure shown is the total number of units in the container, rounded to the nearest manageable fraction.

%Alcohol by Volume	PUB MEASURES					BOTTLES AND CANS						
	Beer Cider 1/2 pint	Beer Cider 1pint	Spirits 1/8 gill	Ver-mouth 1/3 gill	Wine 125ml 4oz	Beer Cider 275ml	Beer Cider 330ml	Beer Cider 440ml	Wines Spirits 70cl	Wines Spirits Cider 75cl	Wines Spirits Beer Cider 1litre	
1%	1/4	1/2	-	-	-	1/4	1/3	1/2	2/3	3/4	1	Low alcohol wines & beers
3%	3/4	1 3/4	-	-	1/3	3/4	1	1 1/3	2	2 1/4	3	Low strength beers
31/2%	1	2	-	-	1/2	1	1 1/4	1 1/2	2 1/2	2 2/3	3 1/3	Standard strength beers & cider
4%	1	2 1/4	-	-	1/2	1	1 1/3	1 3/4	2 3/4	3	4	
41/2%	1 1/4	2 1/2	-	-	1/2	1 1/4	1 1/2	2	3 1/4	3 1/3	4 1/2	
5%	1 1/2	2 3/4	-	-	2/3	1 1/3	1 2/3	2 1/4	3 1/2	3 3/4	5	Export strength beers, strong ciders / Babycham
51/2%	1 1/2	3	-	-	2/3	1 1/2	1 3/4	2 1/2	3 3/4	4	5 1/2	
6%	1 3/4	3 1/2	-	-	3/4	1 2/3	2	2 2/3	4 1/4	4 1/2	6	
8%	2 1/4	4 1/2	-	-	1	2 1/4	2 2/3	3 1/2	5 1/2	6	8	Table wines / Super strength beers / Pomagne
9%	2 1/2	5	-	-	1	2 1/2	3	4	6 1/4	6 3/4	9	
10%	2 3/4	5 2/3	-	-	1 1/4	2 3/4	3 1/3	4 1/2	7	7 1/2	10	
11%	3	6 1/4	-	-	1 1/3	3	3 2/3	4 3/4	7 3/4	8 1/4	11	Barley wine
12%	-	-	-	-	1 1/2	-	-	-	8 1/2	9	12	
13%	-	-	-	-	1 2/3	-	-	-	9	9 3/4	13	
131/2%	-	-	-	-	1 2/3	-	-	-	9 1/2	10 1/4	13 1/2	Ginger wine, Montilla wine
141/2%	-	-	-	3/4	1 3/4	-	-	-	10 1/4	11	14 1/2	Vermouths, Sanatogen
15%	-	-	-	3/4	2	-	-	-	10 1/2	11 1/4	15	British sherry
17%	-	-	-	3/4	2	-	-	-	12	12 3/4	17	Cream liqeurs
171/2%	-	-	-	1	2 1/4	-	-	-	12 1/4	13	17 1/2	Sherry, Advocaat
20%	-	-	-	1	2 1/2	-	-	-	14	15	20	Port
24%	-	-	2/3	1 1/4	3	-	-	-	16 3/4	18	24	Cherry brandy, Campari, Malibu
25%	-	-	2/3	1 1/4	3	-	-	-	17 1/2	18 3/4	25	Pimms
261/2%	-	-	2/3	1 1/3	3 1/3	-	-	-	18 1/2	20	26 1/2	Liqeurs
371/2%	-	-	1	-	4 2/3	-	-	-	26 1/4	28	37 1/2	"Sub-norm" Spirits
40%	-	-	1	-	5	-	-	-	28	30	40	Standard Spirits
43%	-	-	1	-	5 1/3	-	-	-	30	32 1/4	43	"Import" Strength Spirits

Appendix D. Initial questionnaire materials

SMOKER QUESTIONNAIRE

Instructions

This section of the questionnaire gathers information about you and your smoking. Please complete the following sections by filling in the blanks and ticking the appropriate boxes.

General Information

Date of birth: _____

Gender: ☐ Male ☐ Female *(Please tick as appropriate)*

Time of day now: _____

Smoking history

The following questions gather background information about your smoking behaviour. Please fill in the boxes as appropriate.

How old were you when you smoked your first cigarette?	
How long have you been smoking at your current rate?	
When smoking the heaviest, how many cigarettes did you smoke per day?	
How long has it been since you had a cigarette? *(State time elapsed in appropriate units e.g. 5 minutes, 2 weeks, 7 years)*	
Would you class yourself as an occasional/social smoker? *(Please answer "yes" or "no")*	
What brand are you currently smoking?	

Triggers to smoking

The following questions are designed to identify triggers to your smoking. Please answer all the questions. Extra paper is available if you require more writing space. ***Current smokers:*** *please answer the questions so as to reflect your recent (and ongoing) smoking-related experiences.* ***Former smokers:*** *please answer the questions so as to reflect your smoking-related experiences before you stopped smoking. Try to recall your usual smoking behaviour, and the thoughts and feelings that you associated with smoking at the time.*

External

1. Who are/were you usually with when smoking?

_____

_____

2. Where do/did you usually smoke?

3. When do/did you usually smoke?

4. What do/did you usually do while smoking?

5. What other things (e.g. specific sights, smells, and tastes) or events do/did you associate with smoking?

Internal

1. What are/were your thoughts just before smoking?

2. What are/were your feelings just before smoking? (Can you think of specific feelings that you associate with a desire to smoke?)

Trigger Checklist

Do/Did you usually smoke in the following situations? *(Please tick all that apply)*

- ☐ When feeling anxious or under a lot of stress
- ☐ When wanting something in your mouth
- ☐ When relaxing
- ☐ When wanting to cheer up
- ☐ When wanting to keep busy
- ☐ When bored or trying to pass the time
- ☐ When around other smokers
- ☐ When drinking alcoholic beverages
- ☐ When drinking coffee or tea
- ☐ When talking on the telephone
- ☐ When in pain
- ☐ After meals
- ☐ After having sex
- ☐ While at the toilet
- ☐ In the bathtub or shower
- ☐ After exercising
- ☐ While driving a car
- ☐ While putting on makeup or shaving
- ☐ While getting dressed
- ☐ When going out for the evening
- ☐ After leaving work
- ☐ On arrival at work
- ☐ While watching TV
- ☐ While gardening
- ☐ In public buildings
- ☐ While walking down the street
- ☐ At work
- ☐ Inside my house
- ☐ Anywhere inside or around my house
- ☐ In the presence of certain relatives (such as parents, grandparents, in-laws)
- ☐ In presence of my spouse, partner, or children
- ☐ Inside the houses of non-smokers
- ☐ In other peoples' cars
- ☐ In restaurants
- ☐ In a bar
- ☐ During recreation (bowling, etc)

UWIST MOOD ADJECTIVE CHECKLIST

Instructions

This section of the questionnaire is concerned with your current feelings. Please answer ***every*** *question, even if you find it difficult. Answer, as honestly as you can, what is true of* ***you****. Please do not choose a reply just because it seems like the 'right thing to say'. Your answers will be kept entirely confidential. Also, be sure to answer according to how you feel* ***AT THE MOMENT****. Don't just put down how you usually feel. You should try and work quite quickly: there is no need to think very hard about the answers. The first answer you think of is usually the best.*

Here is a list of words that describe people's moods or feelings. Please indicate how well each word describes how you feel ***AT THE MOMENT****. For each word, circle the answer from 1 to 4 which best describes your mood.*

	Definitely	Slightly	Slightly Not	Definitely Not
1. Happy	1	2	3	4
2. Dissatisfied	1	2	3	4
3. Energetic	1	2	3	4
4. Relaxed	1	2	3	4
5. Alert	1	2	3	4
6. Nervous	1	2	3	4
7. Passive	1	2	3	4
8. Cheerful	1	2	3	4
9. Tense	1	2	3	4
10. Jittery	1	2	3	4
11. Sluggish	1	2	3	4
12. Sorry	1	2	3	4
13. Composed	1	2	3	4
14. Depressed	1	2	3	4
15. Restful	1	2	3	4
16. Vigorous	1	2	3	4
17. Anxious	1	2	3	4
18. Satisfied	1	2	3	4
19. Unenterprising	1	2	3	4
20. Sad	1	2	3	4
21. Calm	1	2	3	4
22. Active	1	2	3	4
23. Contented	1	2	3	4
24. Tired	1	2	3	4
25. Impatient	1	2	3	4
26. Annoyed	1	2	3	4
27. Angry	1	2	3	4
28. Irritated	1	2	3	4
29. Grouchy	1	2	3	4

FAGERSTRÖM TEST (current smoker)

Instructions

Please answer the following questions so as to reflect your current smoking behaviour. Indicate your response to each question by ticking the appropriate box below it.

1. How soon after you wake up do you smoke your first cigarette?

- ☐ Within 5 min
- ☐ 5-30 min
- ☐ 31-60 min
- ☐ After 60 min

2. Do you find it difficult to not smoke in places where you shouldn't, such as in church, in school, in a movie, at the library, on the bus, in court, or in the hospital?

- ☐ Yes
- ☐ No

3. Which cigarette would you most hate to give up-which cigarette do you treasure the most?

- ☐ The first one in the morning
- ☐ Any other one

4. How many cigarettes do you smoke each day?

- ☐ 10 or fewer
- ☐ 11-20
- ☐ 21-30
- ☐ 31 or more

5. Do you smoke more during the first few hours after waking up than during the rest of the day?

- ☐ Yes
- ☐ No

6. Do you still smoke if you are so sick that you are in bed most of the day-or if you have a cold or the flu and have trouble breathing?

- ☐ Yes
- ☐ No

QSU-BRIEF FORM

Instructions

*Indicate how much you agree or disagree with each of the following statements by circling the appropriate score on the scale below it, ranging from 1 (you **strongly disagree** with the statement above) to 7 (you **strongly agree** with the statement above). Please complete every item. We are interested in how you are thinking or feeling **right now** as you are filling out the questionnaire.*

1. I have a desire for a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

2. Nothing would be better than smoking a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

3. If it were possible, I probably would smoke now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

4. I could control things better right now if I could smoke.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

5. All I want right now is a cigarette.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

6. I have an urge for a cigarette.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

7. A cigarette would taste good now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

8. I would do almost anything for a cigarette right now.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

9. Smoking would make me less depressed.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**

10. I am going to smoke as soon as possible.

Strongly Disagree 1 2 3 4 5 6 7 **Strongly Agree**